GEORESEARCH, INC.

CLOSURE PLAN

CITY OF LAUREL LANDFILL

NOVEMBER 17, 1992

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November 17, 1992

Mr. Jim Wilbur
Solid and Hazardous Waste Bureau
Department of Health and Environmental Sciences
Cogswell Building
Helena, MT 59620

Dear Jim:

On behalf of the City of Laurel, GeoResearch is submitting the enclosed closure plan for the City of Laurel landfill. This plan addresses the cover, drainage, and revegetation requirements of the state regulations. A hydrogeologic study is currently being completed by GeoResearch and a report on this investigation will be submitted under separate cover.

The City of Laurel would like to close the landfill by December 31, 1992. If you could expedite the review of this plan to allow compliance with that deadline, it would be greatly appreciated. Please call me if you have any questions on the closure plan or would like to meet to discuss it.

Sincerely yours,

Bill Bucher

Bill Bucher, P.E.
Senior Hydrologist

Enc: Closure plan

cc: Jim Worthington - City of Laurel
D. Richardson - GeoResearch

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CLOSURE PLAN

CITY OF LAUREL LANDFILL

Prepared for:

City of Laurel
P.O. Box 10
Laurel, Montana 59044

Prepared by:

GeoResearch, Inc.
P.O. Box 5597
Helena, Montana 59604

November 17, 1992

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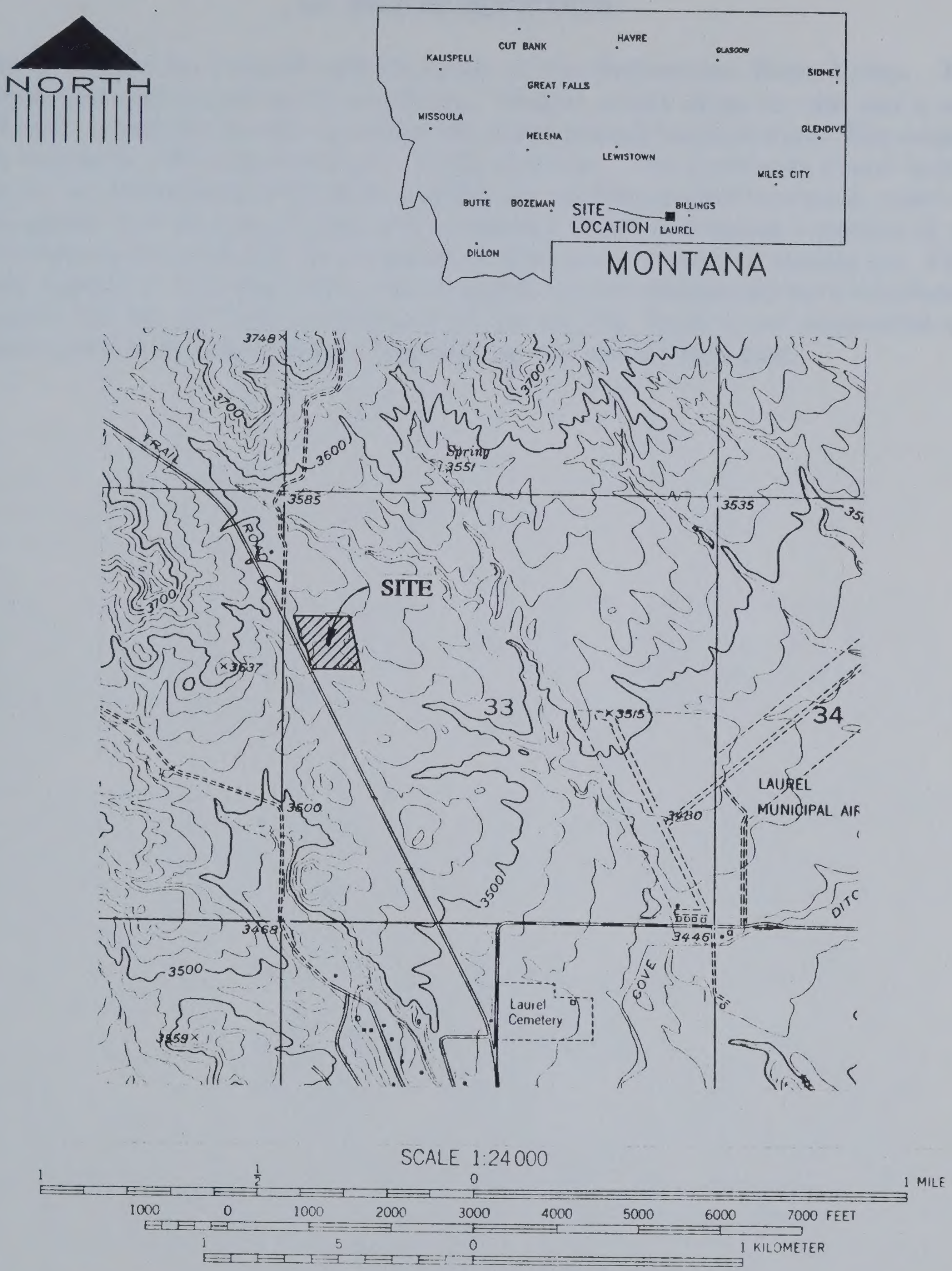
1.0 INTRODUCTION

The City of Laurel is submitting this closure plan for its existing landfill in compliance with Subchapter 5 of Title 16, Chapter 14 of the Administrative Rules of Montana. This closure plan also addresses the final cover requirements of federal rules 40 CFR Section 258 which became effective October 9, 1991. A hydrogeologic investigation, required by Subchapter 7 of Tile 16, Chapter 14 of the Administrative Rules of Montana, is being conducted at this time and will be submitted as a separate document.

The Laurel City landfill is located about three miles north of Laurel on Buffalo Trail Road in Sections 32 and 33 of Township 1 South, Range 24 East, P.M.M. as shown on Figure 1-1. The buried waste is all located on land belonging to the State of Montana and leased from the Department of State Lands under Right-of-Way Deeds. The landfill portions located on the two previous leases, one for 20 acres and the other for 10 acres, have been closed previously. This closure plan addresses the portion most recently used under landfill license no. 203.

Landfill license no. 203 covers 10.02 acres and is located as shown on the accompanying site plan (Sheet 1). This site was licensed on August 5, 1982 and used continuously until about September 1990. The site is licensed as a Class 2 facility to accept municipal wastes. Wastes were buried in pits and the excavated pit soil was used for daily cover. Currently city wastes are hauled to the transfer site adjacent to the landfill where they are transferred for hauling to the Billings City landfill.


NORTH
KALISPELL
CUT BANK
HAVRE
GLASGOW
SIDNEY
GREAT FALLS
MISSOULA
GLENDIVE
HELENA
LEWISTOWN
MILES CITY
BUTTE
BOZEMAN
SITE LOCATION
BILLINGS
LAUREL
DILLON
MONTANA
3748
3700
TRAIL
3600
Spring
3551
3585
3535
ROAD
SITE
3700
3637
33
3515
34
LAUREL
MUNICIPAL AIR
3500
3480
3500
3468
3446
3500
COVE
DITC
Laurel Cemetery
3559
SCALE 1:24000
1
½
0
1 MILE
1000
0
1000
2000
3000
4000
5000
6000
7000 FEET
1
.5
0
1 KILOMETER

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

FIGURE 1 – 1

VICINITY MAP
CITY OF LAUREL LANDFILL
LAUREL, MONTANA

2.0 SITE DESCRIPTION

The site is located on colluvial uplands north of the Yellowstone River Valley. The topography generally slopes to the southeast. Shallow swales drain the site and a well defined swale located north and east of the site drains several hundred acres. The original landfill, started in 1966, lies southwest of this drainage. The previously closed landfill (license no. 24) immediately north of the existing site has been graded to smooth, positively drained, gentle (less than 4:1) slopes with a drainage divide that causes a portion of the runoff to drain to the north and the remainder to drain south toward the existing site. Final cover was applied in 1983 and range grasses (mainly crested wheatgrass) were established. The current site has not been entirely graded and the cap needs to be constructed and vegetation needs to be reestablished. Surrounding land use is range land.

3.0 CLOSURE PLAN

The closure plan addresses cover material, drainage control, revegetation, and site access control measures. Closure construction activities will be carried out by the City of Laurel. Closure should be complete by January 1, 1993 and final inspection will take place immediately following closure.

The final land use after reclamation of the site will be limited grazing under the supervision of the Montana Department of State Lands.

3.1 Cover Material

The landfill will be closed by constructing an 18 inch cap of low permeability which will be covered with at least six inches of growth medium as required by Section 258.60 of the federal rules. Test pits excavated in the existing cover on a 100 foot grid have been used to determine any additional final cover requirements. Approximately 8,300 cubic yards of additional material are needed to meet the requirements of the federal regulations and produce the final contours shown on Sheet 2.

Cover material has been borrowed from area A at the transfer station site as shown on the site plan (Sheet 1). This area is being graded to allow for construction of a new transfer station. The area outlined will be lowered approximately four more feet resulting in about 5,000 cubic yards of material. Additional borrow material is available from Area B (Sheet 1). This material will be used as growth medium.

Soil samples have been collected from the locations shown on the site plan and analyzed for certain of the following parameters: sieve and hydrometer analysis, liquid limit, plastic limit, moisture-density determination, hydraulic conductivity, fertilizer requirements. Table 3-1 summarizes the analyses and laboratory reports for the soil analyses are included in Appendix A.

TABLE 3-1
SOIL SAMPLING SUMMARY

Sample ID	Texture	Atterberg Limits	Moisture-Density	Hydraulic Conductivity	Fertilizer Requirement
L-1	X	X	X		
L-2	X	X		X	
L-3					X
L-4					X

Material sampled from the borrow area A was a gravely clay. The moderately high plasticity index (23%) suggest the material is a rather plastic clay. The material taken from the existing cover did not contain much oversize and consists of a lean clay which is also rather plastic.

Permeability of the existing cover material was checked with a laboratory test. The laboratory test was performed according to ASTM D5084. This procedure measures the hydraulic conductivity of saturated porous material that has been remolded in a flexible wall permeameter. It is a one dimensional measurement that may be related to the vertical field permeability although the remolded material may have different characteristics than the field compacted material. The hydraulic conductivity resulting from testing soil sample L-2 remolded to 90 percent of maximum density with this method was 4.4 x 10^{-6} cm/sec. which meets the federal requirement of 10^{-5} cm/sec.

The cap to be constructed over the waste will be a minimum of 18 inches thick and will have a permeability of 10^{-5} cm/sec or less. Permeability will be checked upon completion of the cap using a double ring infiltrometer (ASTM D3385). Areas that do not meet the permeability requirement will be recompacted.

During construction, the cap will be compacted to ensure that permeability meets the requirement. The cap material shall be moisture conditioned within 2% of optimum moisture content and compacted to a minimum of 90% relative compaction (ASTM D698). Fill shall be compacted in uniform lifts not greater than eight inches in loose thickness. In-place densities will be taken on a grid of 100 feet to ensure that the minimum density requirement is attained. Final cover thickness will be checked at 100 foot grid points that currently have less than two feet of cover. thicknesses will be checked with a soil auger and auger holes will be backfilled and tamped to maintain the integrity of the cover.

Collection of leachate in the landfill should not occur if the cap is constructed to the above specifications because infiltration should be minimal. The landfill base materials are similar to the surface materials but are uncompacted and therefore have a similar or greater permeability than the cap. Any water that does penetrate the cap will not accumulate in the landfill because percolation from the base can occur continuously while infiltration through the cap is anticipated to occur only during prolonged rainstorms and snowmelts.

3.2 Drainage Control

The site shall be contoured to prevent ponding of water. This will be accomplished by building the cap and placing 6 inches of growth medium over the cap resulting in the finished contours shown on Sheet 2.

Run-on shall be prevented by construction of a ditch on the west side of the landfill. A typical section for the ditch is shown on Sheet 2. The west side ditch drains approximately 1.3 acres and is sized larger than needed for a 25 year rain event.

CONTOURS & CLOSED SITE ON SHEET 2

There will be a limited amount of run-on to the existing site from the previously closed site to the north. This water will cross the existing site at its northeast corner and then follow the ditch on the east side of the landfill. Note that there is no buried waste within about 25 feet of the east fence line of the site and drainage of water from the former and existing sites in this ditch will not be over buried waste.

The eastern ditch drains about 14.3 acres and is designed with sufficient capacity to convey the 25 year storm without major erosion damage provided vegetation is established within the ditch. The runoff for the site was calculated using Soil Conservation Service methods assuming a revegetated site with below average infiltration (soils hydrologic group C). The peak flow from the 25 year storm was calculated to be 8.5 cfs. A typical channel cross section is shown on Sheet 2.

3.3 Revegetation

The completed cap will be covered with at least six inches of growth medium. The growth medium will consist of borrow material from areas A and B which contains sufficient fines to retain moisture and promote growth. The growth medium will be amended with fertilizer as needed.

Tests of cover material from areas A and B both have the same fertilizer requirements if they are to be used as a growth medium for crested wheatgrass:

Nitrogen	30 lb/acre
Phosphorus	60 lb/acre
Potassium	40 lb/acre
Sulfur	10 lb/acre
Zinc	3 lb/acre

Laboratory analysis of the soil nutrients and the fertilizer recommendations are included in Appendix A.

Areas in which the growth medium has been compacted will be scarified before planting. The existing landfill area will be seeded in the spring with crested wheatgrass. The seeding rate will be 5 lb PLS/acre if the seed is drilled and double this rate if it is broadcast. The seeding recommendation was obtained from the Billings Soil Conservation Service and is generally applicable in the Billings area. Table 3-2 summarizes the acreages required to be reseeded.

Noxious weeds will be controlled by cutting or spraying during the first two growing seasons until the grass is well established.

TABLE 3-2
REVEGETATION ACREAGE

Location	Area (acres)
Existing Landfill	10.02
Access to Existing Landfill	1.0
Borrow Area A	0.4
Borrow Area B	0.7
Total Acreage	12.12

3.4 Site Access Control

The existing fences will be maintained around the site to prevent dumping and allow establishment of the cover crop. The gate to the closed landfill will be locked and a sign posted declaring the landfill closed. The proximity of the transfer station should prevent dumping at the gate.

3.5 Landfill Gas Collection System

No landfill gas collection system has been incorporated in this design because the low volume of waste does not appear to be producing sufficient quantities of methane to warrant a collection system.

4.0 POST-CLOSURE MAINTENANCE AND MONITORING

The closed landfill will be monitored and maintained to ensure that vegetation is reestablished, that the cap remains intact, that drainage remains positive, erosion damage to the cap or ditches has not occurred, and site access is controlled.

Inspections will be carried out annually and after major rain events to check for erosion of the cap and ditches, differential settling of the cap, and vegetation washout. In addition, fences will be inspected to ensure that there is no access to the site during the reestablishment of vegetation.

Erosion problems will be corrected by revegetation, regrading, and protective coverings such as geotextiles and mulch, if needed. Ditches will be cleared to ensure their proper function. Fences will be repaired to prevent access during the reestablishment of vegetation.

Methane monitoring is not planned due to the low potential for generation of significant gas volumes from the waste. Methane monitoring is not currently required by state or federal regulations.

Monitoring will continue until the Montana Department of Health and Environmental Sciences determines the site is stable.

APPENDIX A
SOIL TESTING LABORATORY REPORTS

hen-Northern, Inc.

A member of the HIH group of companies

600 SOUTH 25TH STREET
P. O. BOX 30615
BILLINGS, MT 59107
(406) 248-9161
FAX (406) 248-9282

TECHNICAL REPORT

AMERICAN COUNCIL OF INDEPENDENT LABORATORIES, INC.

REPORT TO: ATTN: CURT COOVER
GEO RESEARCH, INC.
910 HELENA AVENUE
HELENA, MT 59601

DATE: March 17, 1992
JOB NUMBER: 91-627
SHEET: 1 of 4
INVOICE NO.: 125574

REPORT OF: Laboratory Testing

SAMPLE IDENTIFICATION:

On February 28, 1992, we received two soil samples with instructions to perform two Atterberg Limits tests, two sieve analysis, one hydrometer analysis, one moisture-density determination and one remolded hydraulic conductivity test. The hydraulic conductivity test specimen was remolded to 90 percent of the maximum dry density and optimum moisture content determined from the moisture-density determination. The tests were prepared and performed in general accordance with the ASTM procedures summarized below.

TEST	STANDARD
Liquid limit/plastic limit	ASTM D4318
Sieve and Hydrometer analysis	ASTM D422 and D1140
Moisture-density determination	ASTM D698
Hydraulic conductivity test	ASTM D5084

TEST RESULTS:

Sample No.	Sample Identification	Dry Unit Wt. (pcf)	Moisture Content, (%)	Coefficient Of Hydraulic Conductivity (cm/sec)
1000	L-2	102.6	15.7	4.4×10^{-6}

The results of the liquid limit/plastic limit tests, sieve and hydrometer analysis and the moisture-density determination are included on the attached plates.

Reviewed by: ______________________

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Chen-Northern, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Project: Geo Research

Location: L-1

Classification Clayey GRAVEL

Moisture Content ______ %

Sample No. 1000

Job No. 91-627

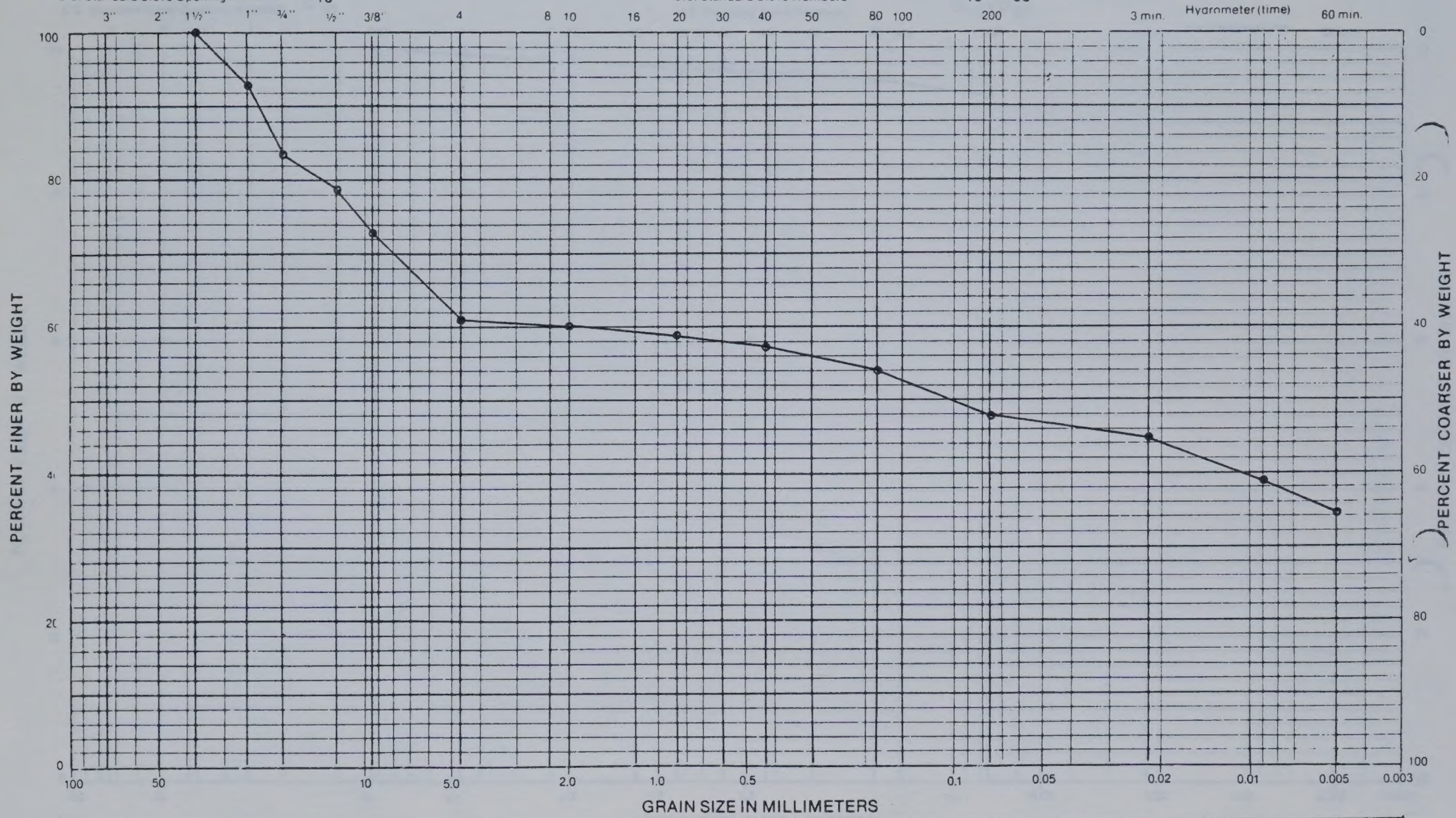
Date March, 1992

Liquid Limit 53 %

Plasticity Index 23 %

Coefficient of Uniformity $= C_U = \frac{D_{60}}{D_{10}} =$ N/A

Coefficient of Curvature $= C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}} =$ N/A



Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

(Rev. 1/89) CNI-105

Chen-Northern, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Project: Geo Research

Location: L-2

Classification Lean CLAY

Moisture Content ______ %

Sample No. 1001

Job No. 91-627

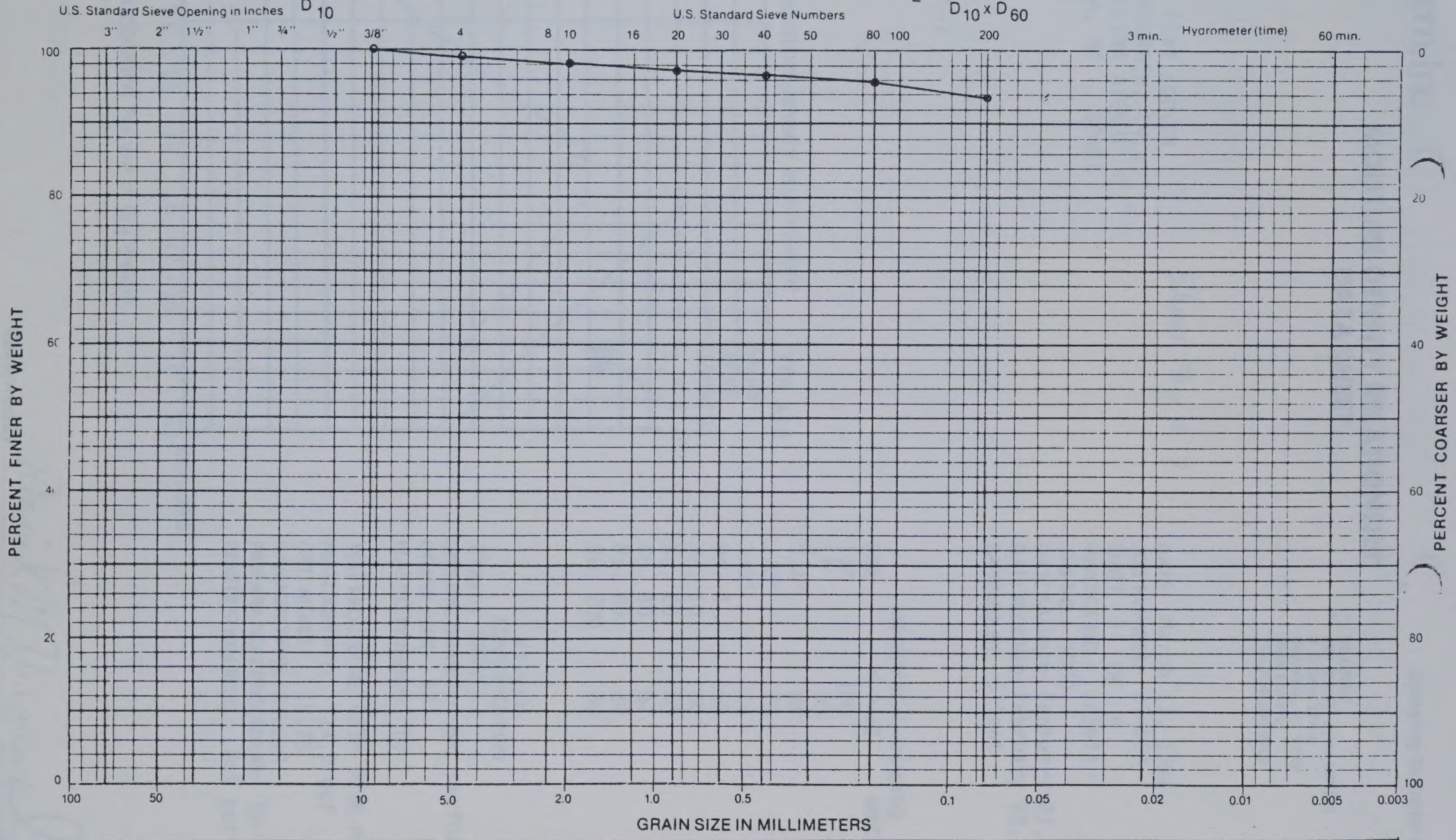
Date March, 1992

Liquid Limit 43 %

Plasticity Index 24 %

Coefficient of Uniformity $= C_U = \frac{D_{60}}{D_{10}} =$ N/A

Coefficient of Curvature $= C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}} =$ N/A



Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

Chen-Northern, Inc.

Consulting Engineers & Scientists

MOISTURE-DENSITY RELATIONSHIP DATA SHEET

☐ **BILLINGS**
600 SOUTH 25TH STREET
P. O. BOX 30615
BILLINGS, MT 59107
(406) 248-9161
FAX (406) 248-9282

Sheet 4 of 4 ?

REPORT TO: ATTN: CURT COOVER
GEO RESEARCH, INC.
910 HELENA AVENUE
HELENA, MT 59601

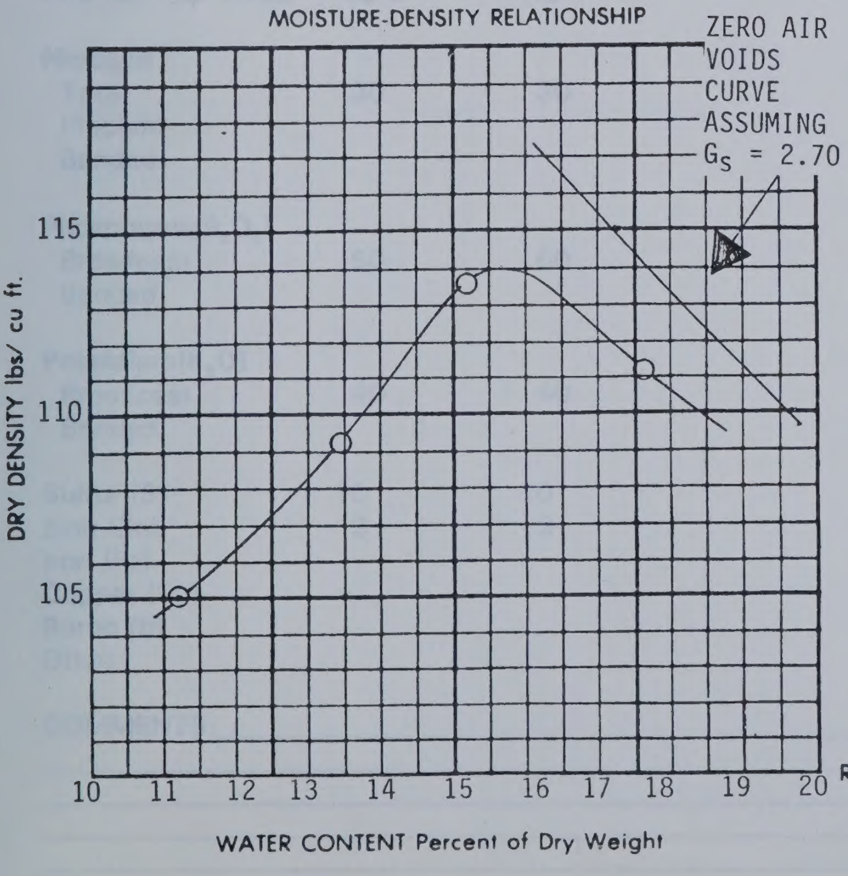
DATE: March 13, 1992
JOB NUMBER: 91-627
SHEET: 3 **OF** 4
INVOICE NO.: 125574
LAB NO.: 1000
DATE SAMPLED: February 27, 1992
DATE RECEIVED: February 28, 1992
SAMPLED BY: Client

PROJECT:
CONTRACTOR:
SAMPLE LOCATION: L-1

MATERIAL USE:

MECHANICAL ANALYSIS

SIZE	% PASS	SPECS.
1½"	100	
1"	93	
3/4"	84	
1/2"	79	
3/8"	73	
No. 4	61	
No. 10	60	
No. 20	59	
No. 40	57	
No. 80	54	
No. 200	48	



Visual
CLASSIFICATION
Clayey GRAVEL
SPECIFIC GRAVITY: Not performed
LIQUID LIMIT: 53
PLASTICITY INDEX: 23

TEST PROCEDURE ASTM D698 Method 'A'
MAX. DENSITY: 114.0 pcf
OPT. MOIST.: 15.7%
RAMMER TYPE: Manual
PREPARATION PROCEDURE: Moist
PENETRATION RESIS.: Not performed

REMARKS:

DISTRIBUTION:

Reviewed By: David M Hummel

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ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: GeoResearch
ADDRESS: P.O. Box 5597
Helena, MT 59604

LAB NO.: 92-43107-08
DATE: 10/30/92 af

FERTILIZER RECOMMENDATIONS

Fertilizer Suggested in Actual Pounds per Acre

Landfill Cover, Laurel Landfill

FIELD	L-4 Surface	L-3 1' Depth
CROP	Crested Wheat	Crested Wheat
PROJECTED YIELD	1.5 T	1.5 T
Nitrogen		
Total	30	30
Preplant		
Banded		
Phosphorus(P_2O_5)		
Broadcast	60	60
Banded		
Potassium(K_2O)		
Broadcast	40	40
Banded		
Sulfur (S)	10	10
Zinc (Zn)	3	3
Iron (Fe)		
Copper (Cu)		
Boron (B)		
Other		

COMMENTS:

PREPARED BY: Neal Fehringer

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

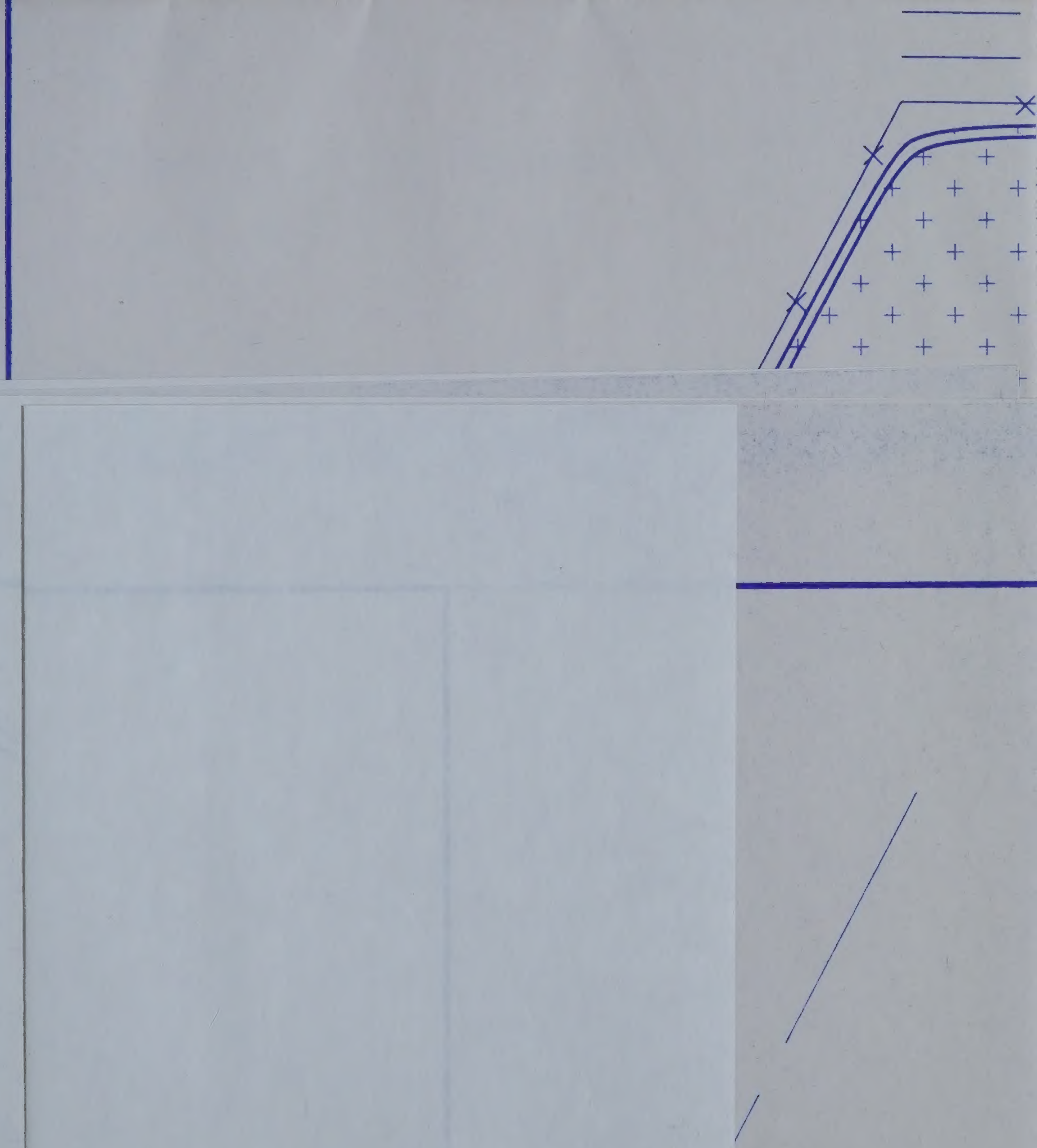
TO: GeoResearch
ADDRESS: P.O. Box 5597
Helena, MT 59604

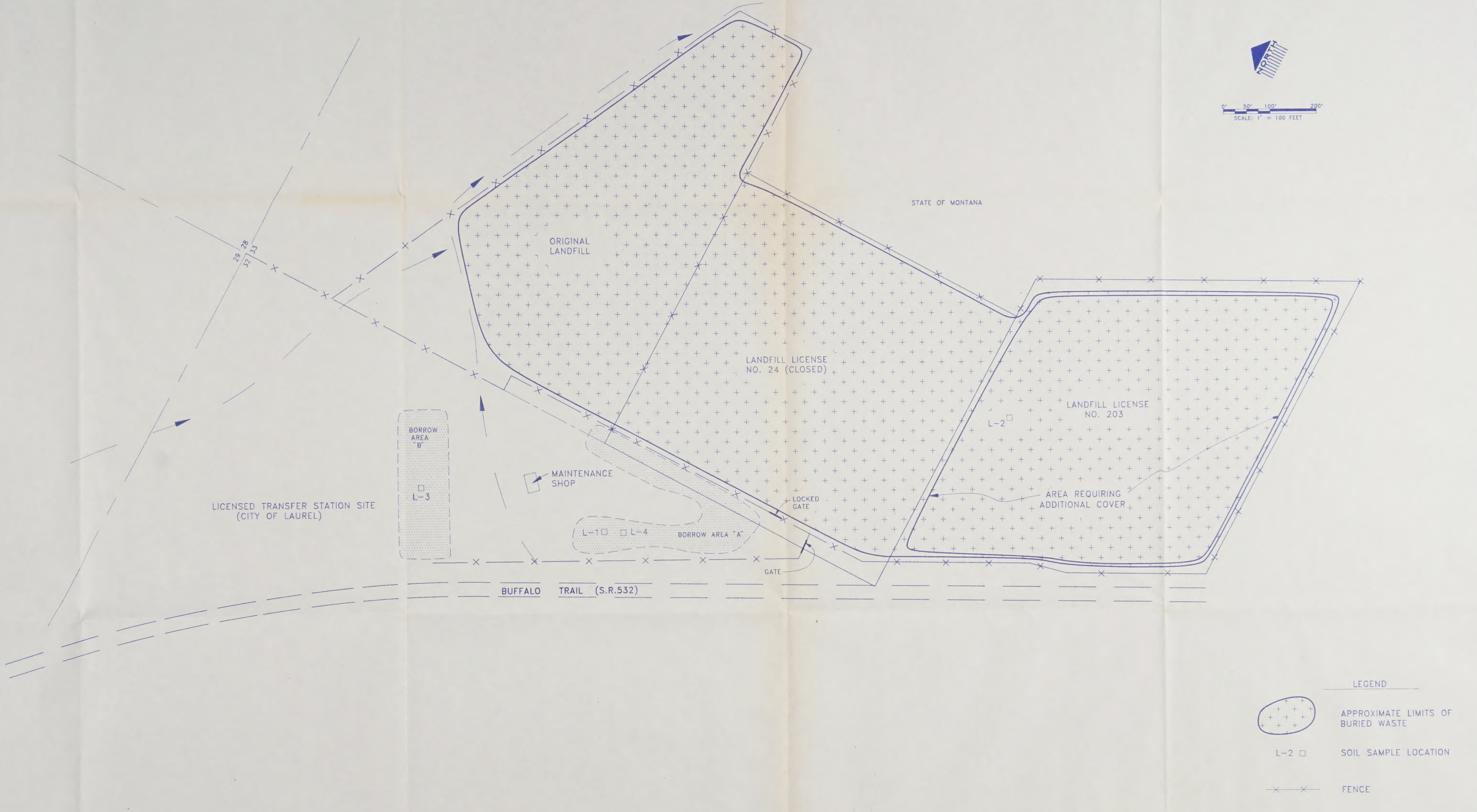
LAB NO.: 92-43107-08
DATE: 10/30/92 af

SOIL ANALYSIS

Landfill Cover, Laurel Landfill
Sampled 10/13/92
Submitted 10/14/92

SAMPLE NO.	43107	43108
FIELD	L-4, Surface	L-3, 1′ Depth
Nitrate-N, μg/g	2.7	1.3
Phosphorus (Olsen) μg/g	<0.1	0.5
Potassium, μg/g	165	139
Zinc, μg/g	<0.1	0.2




NORTH
0' 50' 100' 200'
SCALE: 1" = 100 FEET
STATE OF MONTANA
ORIGINAL LANDFILL
LANDFILL LICENSE NO. 24 (CLOSED)
LANDFILL LICENSE NO. 203
L-2
AREA REQUIRING ADDITIONAL COVER
29 28
32 33
BORROW AREA "B"
L-3
MAINTENANCE SHOP
LICENSED TRANSFER STATION SITE (CITY OF LAUREL)
L-1
L-4
BORROW AREA "A"
LOCKED GATE
GATE
BUFFALO TRAIL (S.R.532)
LEGEND
APPROXIMATE LIMITS OF BURIED WASTE
L-2 □ SOIL SAMPLE LOCATION
FENCE

GEO RESEARCH

SITE PLAN

LAUREL LANDFILL CLOSURE PLAN
LAUREL, MONTANA

DESIGNED BY: WHB
DRAWN BY: SAS
CHECKED BY: WHB
DATE: 11/17/92

SHEET 1

NUMBER	REVISION	BY	DATE

LEGEND

+ + +	APPROXIMATE LIMITS OF BURIED WASTE
L−2 □	SOIL SAMPLE LOCATION
—×——×—	FENCE

SITE PLAN

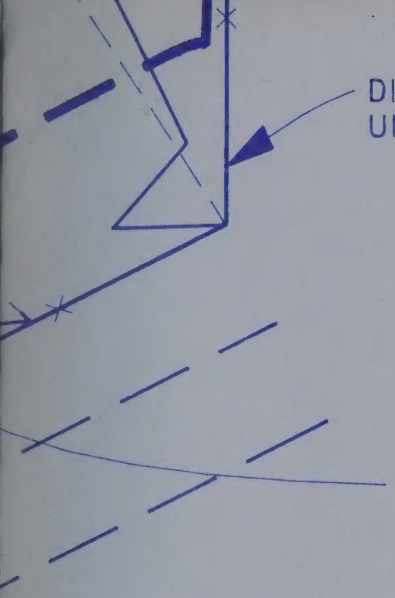
LAUREL LANDFILL CLOSURE PLAN
LAUREL, MONTANA

DESIGNED BY: WHB
DRAWN BY: SAS
CHECKED BY: WHB
DATE: 11/17/92

SHEET 1

NUMBER	REVISION	BY	DATE

O
RCH


DITCH CROSSES
UNDER FENCE
300' DITCH
SECTION Ⓐ
@ 3.4% SLOPE

FINAL GRADING PLAN

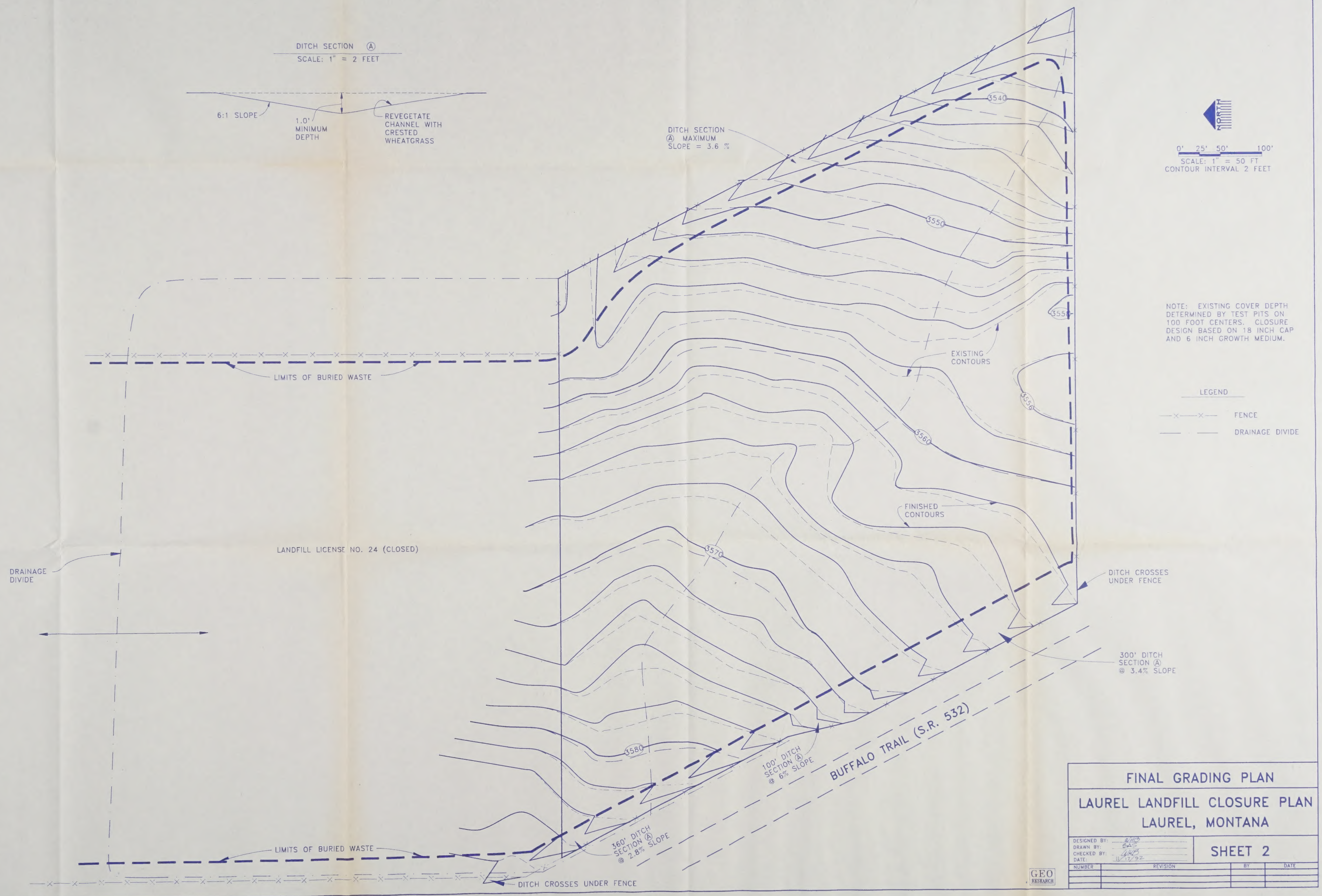
LAUREL LANDFILL CLOSURE PLAN
LAUREL, MONTANA

DESIGNED BY: WHB
DRAWN BY: SAS
CHECKED BY: WHB
DATE: 11/17/92

SHEET 2

NUMBER	REVISION	BY	DATE

GEO
RESEARCH


DITCH SECTION Ⓐ
SCALE: 1" = 2 FEET
6:1 SLOPE
1.0' MINIMUM DEPTH
REVEGETATE CHANNEL WITH CRESTED WHEATGRASS
DITCH SECTION Ⓐ MAXIMUM SLOPE = 3.6 %
NORTH
0' 25' 50' 100'
SCALE: 1" = 50 FT
CONTOUR INTERVAL 2 FEET
3540
3550
3558
3556
3560
3570
3580
EXISTING CONTOURS
FINISHED CONTOURS
LIMITS OF BURIED WASTE
LANDFILL LICENSE NO. 24 (CLOSED)
DRAINAGE DIVIDE
DITCH CROSSES UNDER FENCE
300' DITCH SECTION Ⓐ @ 3.4% SLOPE
100' DITCH SECTION Ⓐ @ 6% SLOPE
360' DITCH SECTION Ⓐ @ 2.8% SLOPE
BUFFALO TRAIL (S.R. 532)
LIMITS OF BURIED WASTE
DITCH CROSSES UNDER FENCE
LEGEND
—×—×— FENCE
— — — DRAINAGE DIVIDE

NOTE: EXISTING COVER DEPTH DETERMINED BY TEST PITS ON 100 FOOT CENTERS. CLOSURE DESIGN BASED ON 18 INCH CAP AND 6 INCH GROWTH MEDIUM.

FINAL GRADING PLAN

LAUREL LANDFILL CLOSURE PLAN
LAUREL, MONTANA

DESIGNED BY: WHB
DRAWN BY: SAS
CHECKED BY: WHB
DATE: 11/17/92

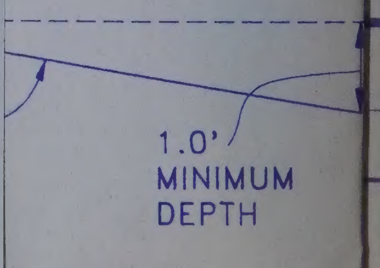
SHEET 2

NUMBER	REVISION	BY	DATE

GEO RESEARCH

DITCH SECT

SCALE: 1”


1.0'
MINIMUM
DEPTH

GEORESEARCH, Inc

CLOSURE PLAN

CITY OF LAUREL LANDFILL

NOVEMBER 17, 1992

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CLOSURE PLAN

CITY OF LAUREL LANDFILL

NOVEMBER 17, 1992

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RECEIVED

NOV 17 1992

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

CLOSURE PLAN

CITY OF LAUREL LANDFILL

Prepared for:

City of Laurel
P.O. Box 10
Laurel, Montana 59044

Prepared by:

GeoResearch, Inc.
P.O. Box 5597
Helena, Montana 59604

November 17, 1992

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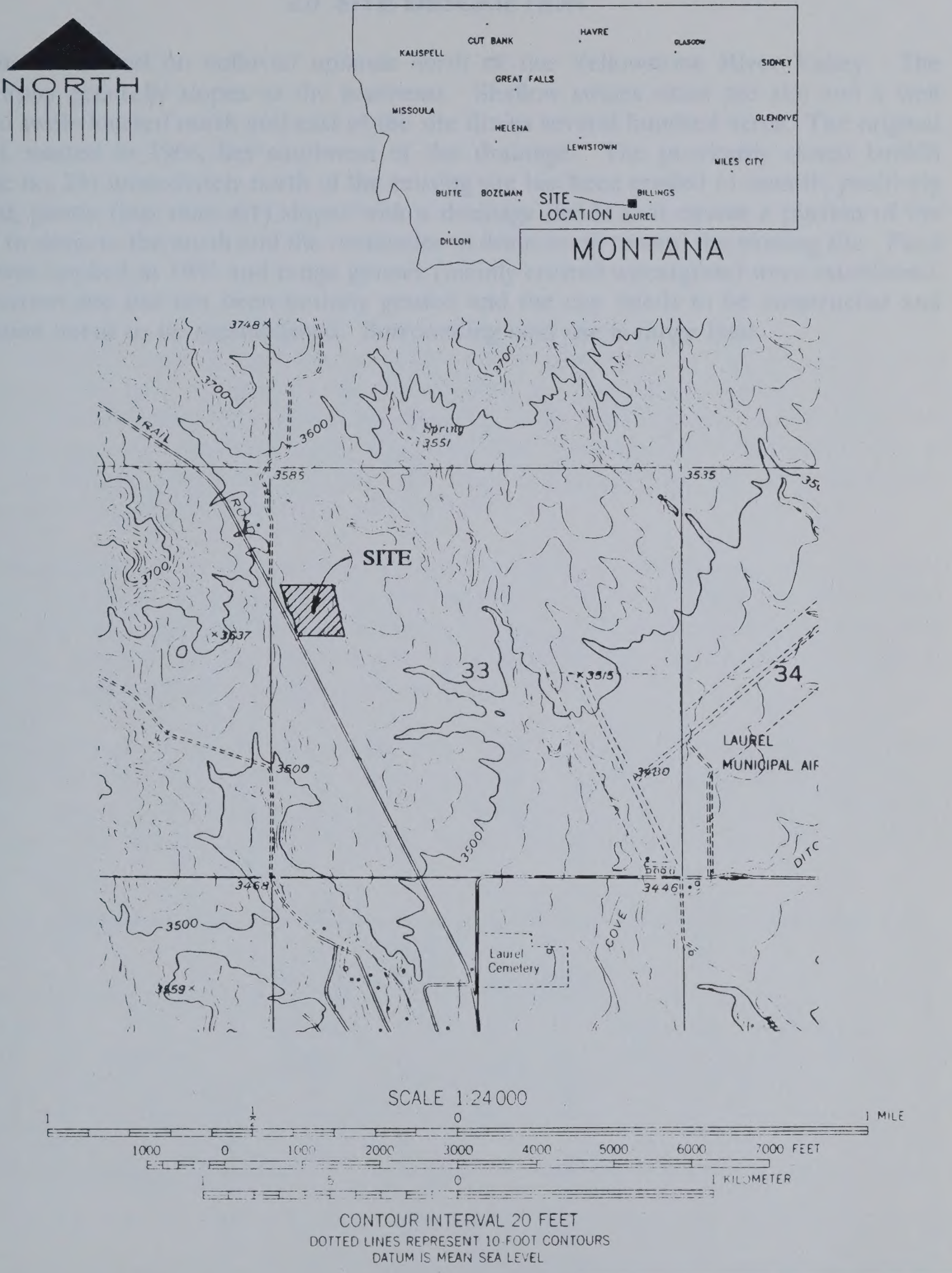
1.0 INTRODUCTION

The City of Laurel is submitting this closure plan for its existing landfill in compliance with Subchapter 5 of Title 16, Chapter 14 of the Administrative Rules of Montana. This closure plan also addresses the final cover requirements of federal rules 40 CFR Section 258 which became effective October 9, 1991. A hydrogeologic investigation, required by Subchapter 7 of Tile 16, Chapter 14 of the Administrative Rules of Montana, is being conducted at this time and will be submitted as a separate document.

The Laurel City landfill is located about three miles north of Laurel on Buffalo Trail Road in Sections 32 and 33 of Township 1 South, Range 24 East, P.M.M. as shown on Figure 1-1. The buried waste is all located on land belonging to the State of Montana and leased from the Department of State Lands under Right-of-Way Deeds. The landfill portions located on the two previous leases, one for 20 acres and the other for 10 acres, have been closed previously. This closure plan addresses the portion most recently used under landfill license no. 203.

Landfill license no. 203 covers 10.02 acres and is located as shown on the accompanying site plan (Sheet 1). This site was licensed on August 5, 1982 and used continuously until about September 1990. The site is licensed as a Class 2 facility to accept municipal wastes. Wastes were buried in pits and the excavated pit soil was used for daily cover. Currently city wastes are hauled to the transfer site adjacent to the landfill where they are transferred for hauling to the Billings City landfill.


NORTH
KALISPELL
CUT BANK
HAVRE
GLASGOW
SIDNEY
GREAT FALLS
MISSOULA
HELENA
GLENDIVE
LEWISTOWN
MILES CITY
BUTTE
BOZEMAN
SITE LOCATION
BILLINGS
LAUREL
DILLON
MONTANA
SITE
3748
3700
3600
Spring
3551
3585
3535
TRAIL
3637
33
34
3515
LAUREL
MUNICIPAL AIR
3500
3480
3468
3446
Laurel Cemetery
COVE
3559
SCALE 1:24 000
1 MILE
7000 FEET
1 KILOMETER
CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

GEO RESEARCH

FIGURE 1 – 1

VICINITY MAP
CITY OF LAUREL LANDFILL
LAUREL, MONTANA

2.0 SITE DESCRIPTION

The site is located on colluvial uplands north of the Yellowstone River Valley. The topography generally slopes to the southeast. Shallow swales drain the site and a well defined swale located north and east of the site drains several hundred acres. The original landfill, started in 1966, lies southwest of this drainage. The previously closed landfill (license no. 24) immediately north of the existing site has been graded to smooth, positively drained, gentle (less than 4:1) slopes with a drainage divide that causes a portion of the runoff to drain to the north and the remainder to drain south toward the existing site. Final cover was applied in 1983 and range grasses (mainly crested wheatgrass) were established. The current site has not been entirely graded and the cap needs to be constructed and vegetation needs to be reestablished. Surrounding land use is range land.

3.0 CLOSURE PLAN

The closure plan addresses cover material, drainage control, revegetation, and site access control measures. Closure construction activities will be carried out by the City of Laurel. Closure should be complete by January 1, 1993 and final inspection will take place immediately following closure.

The final land use after reclamation of the site will be limited grazing under the supervision of the Montana Department of State Lands.

3.1 Cover Material

The landfill will be closed by constructing an 18 inch cap of low permeability which will be covered with at least six inches of growth medium as required by Section 258.60 of the federal rules. Test pits excavated in the existing cover on a 100 foot grid have been used to determine any additional final cover requirements. Approximately 8,300 cubic yards of additional material are needed to meet the requirements of the federal regulations and produce the final contours shown on Sheet 2.

Cover material has been borrowed from area A at the transfer station site as shown on the site plan (Sheet 1). This area is being graded to allow for construction of a new transfer station. The area outlined will be lowered approximately four more feet resulting in about 5,000 cubic yards of material. Additional borrow material is available from Area B (Sheet 1). This material will be used as growth medium.

Soil samples have been collected from the locations shown on the site plan and analyzed for certain of the following parameters: sieve and hydrometer analysis, liquid limit, plastic limit, moisture-density determination, hydraulic conductivity, fertilizer requirements. Table 3-1 summarizes the analyses and laboratory reports for the soil analyses are included in Appendix A.

TABLE 3-1
SOIL SAMPLING SUMMARY

Sample ID	Texture	Atterberg Limits	Moisture-Density	Hydraulic Conductivity	Fertilizer Requirement
L-1	X	X	X		
L-2	X	X		X	
L-3					X
L-4					X

Material sampled from the borrow area A was a gravely clay. The moderately high plasticity index (23%) suggest the material is a rather plastic clay. The material taken from the existing cover did not contain much oversize and consists of a lean clay which is also rather plastic.

Permeability of the existing cover material was checked with a laboratory test. The laboratory test was performed according to ASTM D5084. This procedure measures the hydraulic conductivity of saturated porous material that has been remolded in a flexible wall permeameter. It is a one dimensional measurement that may be related to the vertical field permeability although the remolded material may have different characteristics than the field compacted material. The hydraulic conductivity resulting from testing soil sample L-2 remolded to 90 percent of maximum density with this method was 4.4×10^{-6} cm/sec. which meets the federal requirement of 10^{-5} cm/sec.

The cap to be constructed over the waste will be a minimum of 18 inches thick and will have a permeability of 10^{-5} cm/sec or less. Permeability will be checked upon completion of the cap using a double ring infiltrometer (ASTM D3385). Areas that do not meet the permeability requirement will be recompacted.

During construction, the cap will be compacted to ensure that permeability meets the requirement. The cap material shall be moisture conditioned within 2% of optimum moisture content and compacted to a minimum of 90% relative compaction (ASTM D698). Fill shall be compacted in uniform lifts not greater than eight inches in loose thickness. In-place densities will be taken on a grid of 100 feet to ensure that the minimum density requirement is attained. Final cover thickness will be checked at 100 foot grid points that currently have less than two feet of cover. thicknesses will be checked with a soil auger and auger holes will be backfilled and tamped to maintain the integrity of the cover.

Collection of leachate in the landfill should not occur if the cap is constructed to the above specifications because infiltration should be minimal. The landfill base materials are similar to the surface materials but are uncompacted and therefore have a similar or greater permeability than the cap. Any water that does penetrate the cap will not accumulate in the landfill because percolation from the base can occur continuously while infiltration through the cap is anticipated to occur only during prolonged rainstorms and snowmelts.

3.2 Drainage Control

The site shall be contoured to prevent ponding of water. This will be accomplished by building the cap and placing 6 inches of growth medium over the cap resulting in the finished contours shown on Sheet 2.

Run-on shall be prevented by construction of a ditch on the west side of the landfill. A typical section for the ditch is shown on Sheet 2. The west side ditch drains approximately 1.3 acres and is sized larger than needed for a 25 year rain event.

There will be a limited amount of run-on to the existing site from the previously closed site to the north. This water will cross the existing site at its northeast corner and then follow the ditch on the east side of the landfill. Note that there is no buried waste within about 25 feet of the east fence line of the site and drainage of water from the former and existing sites in this ditch will not be over buried waste.

The eastern ditch drains about 14.3 acres and is designed with sufficient capacity to convey the 25 year storm without major erosion damage provided vegetation is established within the ditch. The runoff for the site was calculated using Soil Conservation Service methods assuming a revegetated site with below average infiltration (soils hydrologic group C). The peak flow from the 25 year storm was calculated to be 8.5 cfs. A typical channel cross section is shown on Sheet 2.

3.3 Revegetation

The completed cap will be covered with at least six inches of growth medium. The growth medium will consist of borrow material from areas A and B which contains sufficient fines to retain moisture and promote growth. The growth medium will be amended with fertilizer as needed.

Tests of cover material from areas A and B both have the same fertilizer requirements if they are to be used as a growth medium for crested wheatgrass:

Nitrogen	30 lb/acre
Phosphorus	60 lb/acre
Potassium	40 lb/acre
Sulfur	10 lb/acre
Zinc	3 lb/acre

Laboratory analysis of the soil nutrients and the fertilizer recommendations are included in Appendix A.

Areas in which the growth medium has been compacted will be scarified before planting. The existing landfill area will be seeded in the spring with crested wheatgrass. The seeding rate will be 5 lb PLS/acre if the seed is drilled and double this rate if it is broadcast. The seeding recommendation was obtained from the Billings Soil Conservation Service and is generally applicable in the Billings area. Table 3-2 summarizes the acreages required to be reseeded.

Noxious weeds will be controlled by cutting or spraying during the first two growing seasons until the grass is well established.

TABLE 3-2
REVEGETATION ACREAGE

Location	Area (acres)
Existing Landfill	10.02
Access to Existing Landfill	1.0
Borrow Area A	0.4
Borrow Area B	0.7
Total Acreage	12.12

3.4 Site Access Control

The existing fences will be maintained around the site to prevent dumping and allow establishment of the cover crop. The gate to the closed landfill will be locked and a sign posted declaring the landfill closed. The proximity of the transfer station should prevent dumping at the gate.

3.5 Landfill Gas Collection System

No landfill gas collection system has been incorporated in this design because the low volume of waste does not appear to be producing sufficient quantities of methane to warrant a collection system.

4.0 POST-CLOSURE MAINTENANCE AND MONITORING

The closed landfill will be monitored and maintained to ensure that vegetation is reestablished, that the cap remains intact, that drainage remains positive, erosion damage to the cap or ditches has not occurred, and site access is controlled.

Inspections will be carried out annually and after major rain events to check for erosion of the cap and ditches, differential settling of the cap, and vegetation washout. In addition, fences will be inspected to ensure that there is no access to the site during the reestablishment of vegetation.

Erosion problems will be corrected by revegetation, regrading, and protective coverings such as geotextiles and mulch, if needed. Ditches will be cleared to ensure their proper function. Fences will be repaired to prevent access during the reestablishment of vegetation.

Methane monitoring is not planned due to the low potential for generation of significant gas volumes from the waste. Methane monitoring is not currently required by state or federal regulations.

Monitoring will continue until the Montana Department of Health and Environmental Sciences determines the site is stable.

APPENDIX A
SOIL TESTING LABORATORY REPORTS

Chen-Northern, Inc.

A member of the HIH group of companies

600 SOUTH 25TH STREET
P. O. BOX 30615
BILLINGS, MT 59107
(406) 248-9161
FAX (406) 248-9282

TECHNICAL REPORT

REPORT TO: ATTN: CURT COOVER
GEO RESEARCH, INC.
910 HELENA AVENUE
HELENA, MT 59601

DATE: March 17, 1992
JOB NUMBER: 91-627
SHEET: 1 of 4
INVOICE NO.: 125574

REPORT OF: Laboratory Testing

SAMPLE IDENTIFICATION:

On February 28, 1992, we received two soil samples with instructions to perform two Atterberg Limits tests, two sieve analysis, one hydrometer analysis, one moisture-density determination and one remolded hydraulic conductivity test. The hydraulic conductivity test specimen was remolded to 90 percent of the maximum dry density and optimum moisture content determined from the moisture-density determination. The tests were prepared and performed in general accordance with the ASTM procedures summarized below.

TEST	STANDARD
Liquid limit/plastic limit	ASTM D4318
Sieve and Hydrometer analysis	ASTM D422 and D1140
Moisture-density determination	ASTM D698
Hydraulic conductivity test	ASTM D5084

TEST RESULTS:

Sample No.	Sample Identification	Dry Unit Wt. (pcf)	Moisture Content, (%)	Coefficient Of Hydraulic Conductivity (cm/sec)
1000	L-2	102.6	15.7	4.4×10^{-6}

The results of the liquid limit/plastic limit tests, sieve and hydrometer analysis and the moisture-density determination are included on the attached plates.

Reviewed by: ______________________

ro

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Chen-Northern, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Project: Geo Research

Location: L-1

Classification Clayey GRAVEL

Moisture Content ________ %

Liquid Limit 53 %

Sample No. 1000

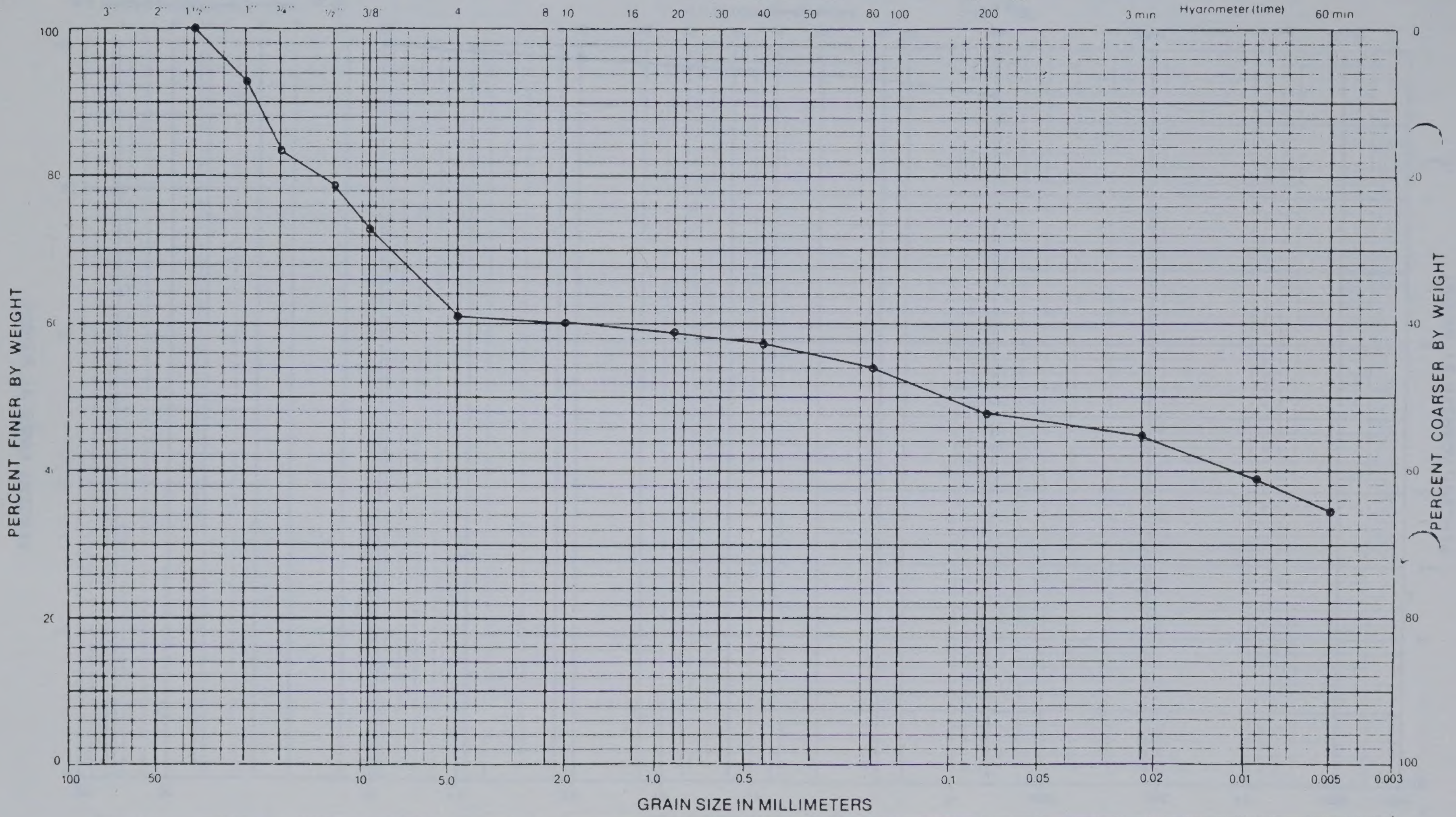
Job No. 91-627

Date March, 1992

Plasticity Index 23 %

Coefficient of Uniformity $= C_U = \frac{D_{60}}{D_{10}} =$ N/A

Coefficient of Curvature $= C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}} =$ N/A



Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

(Rev. 1/89) CNI-105

Chen-Northern, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Project: Geo Research

Location: L-2

Classification: Lean CLAY

Moisture Content ______ %

Sample No. 1001

Job No. 91-627

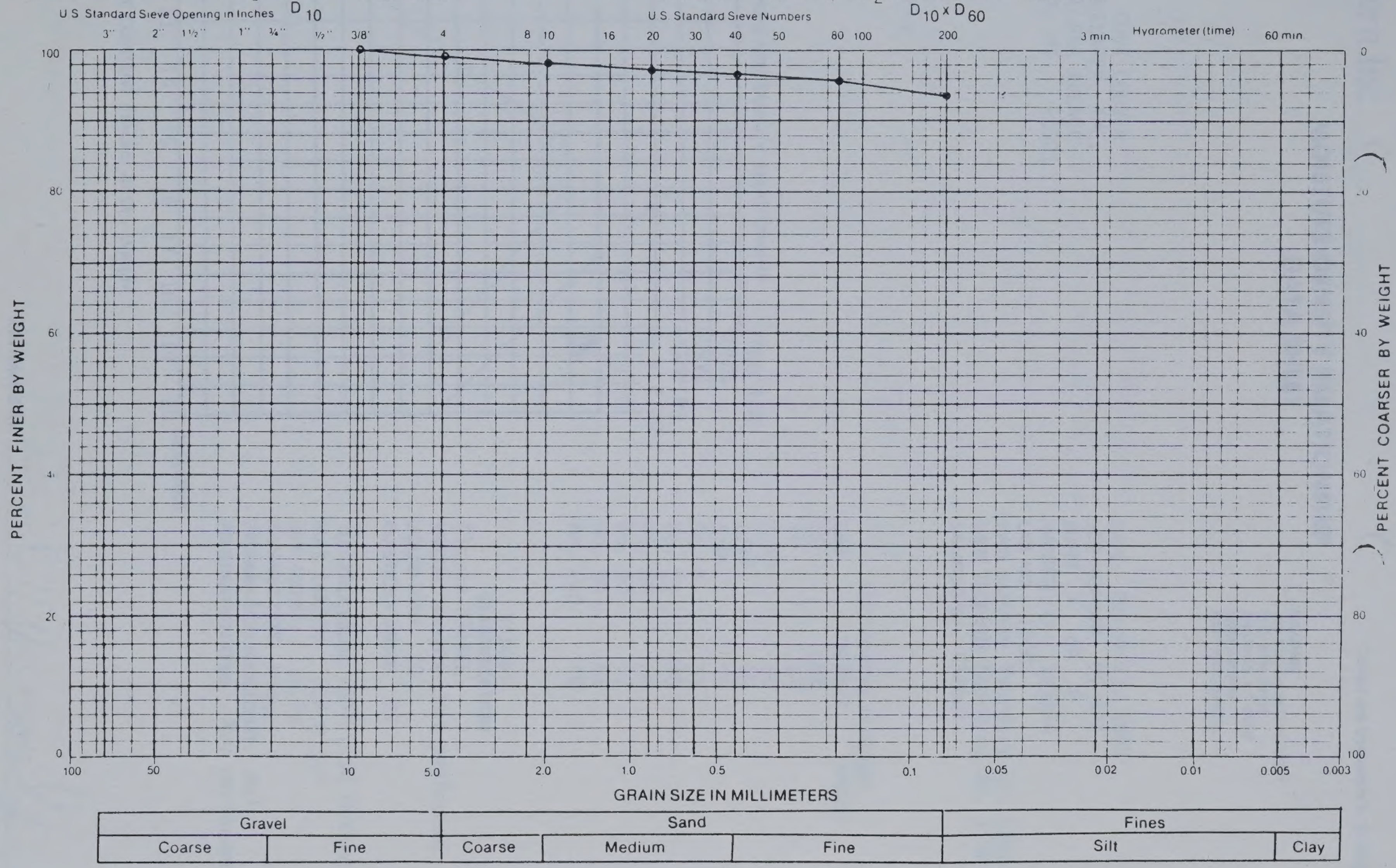
Date March, 1992

Liquid Limit 43 %

Plasticity Index 24 %

Coefficient of Uniformity $= C_U = \frac{D_{60}}{D_{10}} =$ N/A

Coefficient of Curvature $= C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}} =$ N/A



Chen-Northern, Inc.
Consulting Engineers & Scientists

☐ BILLINGS
600 SOUTH 25TH STREET
P. O. BOX 30615
BILLINGS, MT 59107
(406) 248-9161
FAX (406) 248-9282

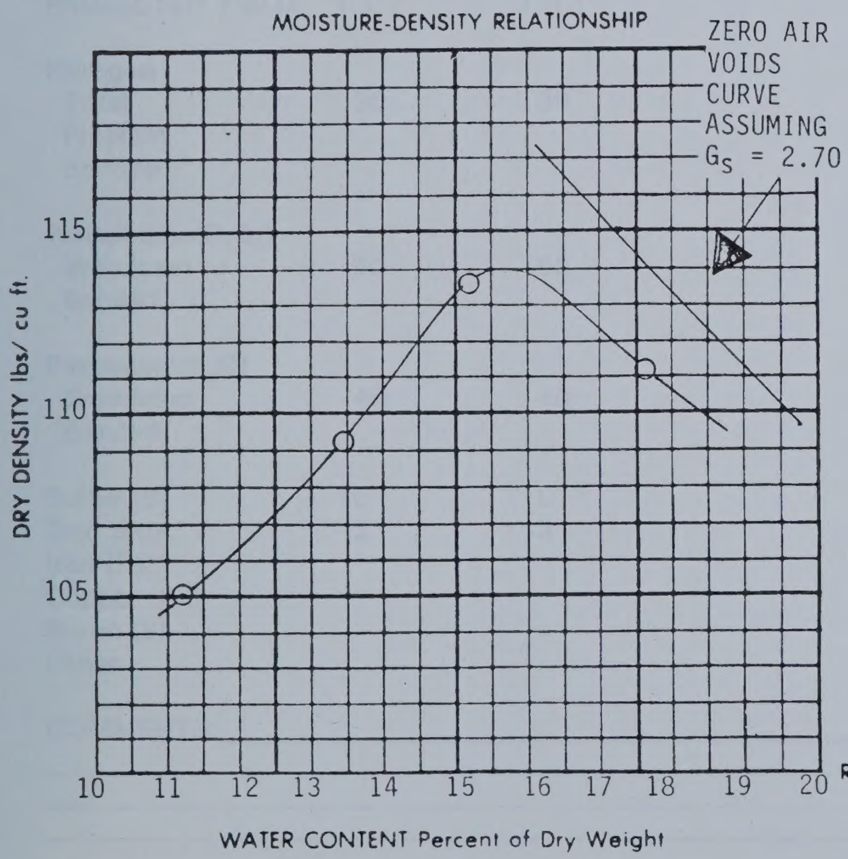
MOISTURE-DENSITY RELATIONSHIP DATA SHEET

REPORT TO: ATTN: CURT COOVER
GEO RESEARCH, INC.
910 HELENA AVENUE
HELENA, MT 59601

DATE: March 13, 1992
JOB NUMBER: 91-627
SHEET: 3 OF 4
INVOICE NO.: 125574
LAB NO.: 1000
DATE SAMPLED: February 27, 1992
DATE RECEIVED: February 28, 1992
SAMPLED BY: Client

PROJECT:
CONTRACTOR:
SAMPLE LOCATION: L-1

MATERIAL USE:



MECHANICAL ANALYSIS

SIZE	% PASS	SPECS.
1½"	100	
1"	93	
3/4"	84	
1/2"	79	
3/8"	73	
No. 4	61	
No. 10	60	
No. 20	59	
No. 40	57	
No. 80	54	
No. 200	48	

Visual
CLASSIFICATION
Clayey GRAVEL
SPECIFIC GRAVITY: Not performed
LIQUID LIMIT: 53
PLASTICITY INDEX: 23

TEST PROCEDURE ASTM D698 Method
MAX. DENSITY: 114.0 pcf
OPT. MOIST.: 15.7%
RAMMER TYPE: Manual
PREPARATION PROCEDURE: Moist
PENETRATION RESIS.: Not performed

REMARKS:

DISTRIBUTION:

Reviewed By:

ro

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ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: GeoResearch
ADDRESS: P.O. Box 5597
Helena, MT 59604

LAB NO.: 92-43107-08
DATE: 10/30/92 af

FERTILIZER RECOMMENDATIONS

Fertilizer Suggested in Actual Pounds per Acre

Landfill Cover, Laurel Landfill

FIELD	L-4 Surface	L-3 1′ Depth
CROP	Crested Wheat	Crested Wheat
PROJECTED YIELD	1.5 T	1.5 T
Nitrogen		
Total	30	30
Preplant		
Banded		
Phosphorus(P_2O_5)		
Broadcast	60	60
Banded		
Potassium(K_2O)		
Broadcast	40	40
Banded		
Sulfur (S)	10	10
Zinc (Zn)	3	3
Iron (Fe)		
Copper (Cu)		
Boron (B)		
Other		

COMMENTS:

PREPARED BY: Neal Fehringer

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: GeoResearch
ADDRESS: P.O. Box 5597
Helena, MT 59604

LAB NO.: 92-43107-08
DATE: 10/30/92 af

SOIL ANALYSIS

Landfill Cover, Laurel Landfill
Sampled 10/13/92
Submitted 10/14/92

SAMPLE NO.	43107	43108
FIELD	L-4, Surface	L-3, 1′ Depth
Nitrate-N, μg/g	2.7	1.3
Phosphorus (Olsen) μg/g	<0.1	0.5
Potassium, μg/g	165	139
Zinc, μg/g	<0.1	0.2

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GEORESEARCH, INC.

Post Closure Plan

City of Laurel Landfill

February 3, 1994

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MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
[illegible] HAZARDOUS WASTE BUREAU

GEO RESEARCH®

Post Closure Plan

City of Laurel Landfill

February 3, 1994

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FEB 07 1994
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

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February 3, 1994

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MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

Ms. Pat Potts
Environmental Specialist
Dept. of Health & Env. Sciences
Solid & Hazardous Waste Bureau
836 Front Street
Helena, MT 59620-0901

Dear Ms. Potts:

Enclosed please find four copies of the Post Closure Plan for the Laurel Landfill License #203.

Upon authorization from the City of Laurel, GeoResearch anticipates conducting groundwater sampling at Laurel Landfill as required in your February 1, 1994, letter. Sampling procedures detailed in the Post Closure Plan will be used.

If you have any questions, please don't hesitate to call.

Sincerely,

Margaret M. Hofacker

Margaret M. Hofacker
Environmental Engineer

115 North Broadway
Billings, MT 59101
TEL. (406) 248-6771
FAX (406) 248-6770

Post Closure Plan
City of Laurel Landfill License #203
Laurel, Montana

Prepared for:

The City of Laurel
P. O. Box 10
Laurel, Montana 59044

Prepared by:

GeoResearch, Inc.
115 North Broadway
Billings, Montana 59101

February 3, 1994

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Post Closure Plan
City of Laurel Landfill
Laurel, Montana

1.0 INTRODUCTION

This Post Closure Plan provides the detailed procedures and schedules for continuing care of the Laurel Landfill Site specified in License #203 during its designated post closure period. Post Closure Care Requirements for Class II Landfills presented at ARM 16.14. 531 include maintenance of the final cover, maintenance of the leachate system, monitoring of groundwater, and maintenance of a gas monitoring system according to a written plan. The period of post closure care is set at 30 years which may be increased or decreased by the Montana Department of Health and Environmental Sciences Solid Waste Program (MSWP).

The Laurel Landfill stopped receiving waste in September 1990. The written Closure Plan required by ARM 16.14.530(1)(c) was approved by the MSWP on December 17, 1992, and MSWP closure inspections were conducted on March 5 and June 21, 1993. The MSWP letter verifying closure is dated August 23, 1993. By virtue of the regulations found at ARM 16.14.501(5) the Laurel Landfill is only subject to the final cover requirements of Sub-Chapter 5. The final cover must be installed no later than October 9, 1994, otherwise, the Laurel Landfill becomes subject to all requirements of ARM 16.14 Sub-Chapter 5 including methane monitoring and leachate collection. Closure does not release Laurel Landfill from groundwater monitoring.

This plan includes a Final Cover Maintenance Plan, Section 2.0, and a Groundwater Monitoring Plan, comprised of Sections 3.0, 4.0, and 5.0, and a Health and Safety Plan, Section 6.0.

1.1 Site Description

The Laurel Landfill site consists of several adjacent parcels totaling approximately 40 acres in Sections 32 and 33, Township 1 South, Range 24 East, P.M.M., in Yellowstone County. The site lies approximately two miles north of the City of Laurel on State Route 532, Buffalo Trail Road (See Figure 1 on page 6). The property is owned by the State of Montana and the City of Laurel leases the property from the Montana Department of State Lands under a Right-of-Way Deed.

According to file information obtained from the Montana Solid Waste Program, a dump site was opened in 1965 in the vicinity of the subject site. A ten acre site located in the NW¼ of Section 33 was licensed as a landfill (License #24) in 1978 and closed in 1983. The subject site was licensed as a Class II municipal solid waste landfill in 1982 as an expansion of the License #24 area and comprises 10.02 acres

located in the SW¼ NW¼, Section 33. The City of Laurel stopped burying waste at the site in September 1990. Waste is currently collected at a transfer station northwest of the subject site in preparation for hauling to the City of Billings Landfill (See Figure 2 on page 7). The surrounding land is used as rangeland.

Previous work at the Landfill site includes closure as detailed in the Closure Plan (GeoResearch, November 17, 1992), a 1992 hydrogeological and soils study detailed in a Hydrogeological and Soils Study status update (GeoResearch, December 31, 1992), and additional hydrogeological and soil investigations in 1993 with details to be presented in a final Hydrogeological and Soils Study Report in the first quarter of 1994 (report in process).

1.2 Responsible Person

Implementation of this Post Closure Plan is the responsibility of The Public Works Director for the City of Laurel who is also the contact person specified in ARM 16.14.531(c)(iii). The contact address is:

Public Works Director
City of Laurel
115 West First Street
P. O. Box 10
Laurel, Montana 59044
Phone: (406) 628-8791
Fax: (406) 628-4641

1.3 Record Keeping

The monitoring and maintenance activities and frequencies as required by ARM 16.14.531, are presented in Table 1 on page 5. The person responsible for implementation of post closure care at the Laurel Landfill will make certain that forms are completed according to the required schedule and that records are retained in the operating record per ARM 16.14.521(1)(p). Annual and other reporting tasks as required by the MSWP (see Section 1.4) are also the responsibility of this person.

Field records are kept in a waterproof Site Log Book which refers to waterproof Field Log Books comprised of detailed field sampling documentation forms. All field data will be recorded using a permanent marker. Field notes will be included in the appropriate reports and as such become part of the operating record for the Laurel Landfill License #203. Reports of field activities and sampling results will be presented to the City of Laurel by the field personnel upon completion of data evaluation and report composition.

A copy of the approved Post Closure Plan will be kept at the office of the Director of Public Works for the City of Laurel. A second copy will be kept at the offices of the field sampling personnel per ARM 16.14.706(6). Any revisions to the approved Post Closure Plan will be kept in the same locations and the most recent approved revision will be followed for field activities.

As required in ARM 16.14.521(1)(p), records of inspections, notifications procedures, and groundwater monitoring demonstrations, findings, testing, and analytical data generated by actions required by this Post Closure Plan will become part of the operating record.

1.4 Reporting

Required reports specified pursuant to ARM 16.14.707 include:

- Hydrogeological and Soils Study;
- Annual report of all groundwater sampling activities, static water elevations, modifications to the monitoring well network, inspections, maintenance activities and construction or operational events which may affect the monitoring well network;
- Report of new well construction, development or rehabilitation within 90 days of the start of work, or as part of another in-progress report; and,
- Revisions and updates to the Groundwater Monitoring Plan at least every five years or more frequently if significant changes in the groundwater monitoring system or procedures occur.

In addition, notification of MSWP is required by:

- ARM 16.14.707(15) which requires a report of sampling results, water elevation data, direction of groundwater flow, and rate of groundwater flow within 90 days of sampling; or,
- ARM 16.14.708(1)(a) and (i) which require that any groundwater sampling laboratory results that indicate downgradient concentrations equal to or exceeding background levels be reported to MSWP within 14 days of discovery of the exceedence;
- ARM 16.14.706(4)(2) which requires that the direction of groundwater flow and the rate of groundwater flow will be determined and included in the reports for each sampling and monitoring event;

- ARM 16.14.521(p and q) which requires that reports, including field notes, and other records be retained in the operating record and the MSWP be notified when documents have been added to the operating record;

- ARM 16.14.715(2) which requires that the discovery of a monitoring well which has been destroyed or is otherwise incapable of functioning properly will be reported to the MSWP within 10 days and repaired or abandoned and replaced within 90 days; and,

- ARM 16.14.715(2) which requires that documentation of the rehabilitation or replacement of a damaged well be presented to the MSWP within 90 days unless the information can be appended to another report which is in preparation at the time.

1.5 Duration of Post Closure Care

The duration of the post closure period will be thirty years unless a satisfactory demonstration can be made to the MSWP that a shorter period is sufficient to protect human health and the environment pursuant to ARM 16.14.531(1)(b). A longer post closure period may be required by MSWP if a determination is made that the lengthened period is necessary to protect human health and the environment.

Upon completion of the post closure period, ARM 16.14.531(1)(e)requires certification by an independent registered professional engineer that post closure care has been completed in accordance with the Post Closure Plan. The certification must be approved by MSWP and a copy of the approved document placed into the operating record.

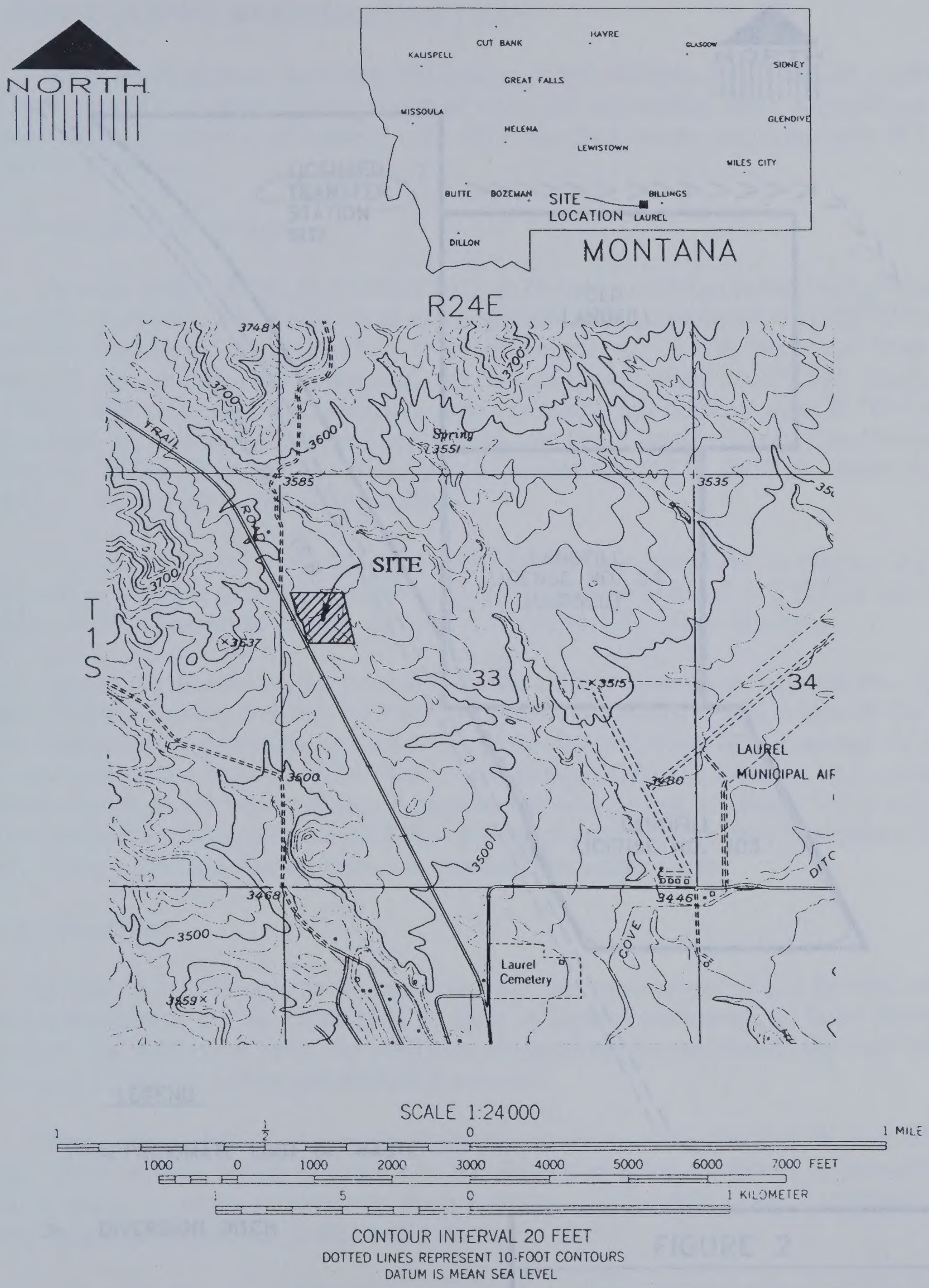
1.6 Planned Property Uses

A description of the planned uses of the property during the post closure period is required at ARM 16.14.531(1)(c).

At this time GeoResearch recommends that the land be left undisturbed and unused for at least the first two growing seasons after revegetation of the cover. This period will permit establishment of the planted grasses. After vegetation is well established, the land may be usable for open range or livestock grazing which is the current use of the land surrounding the Laurel Landfill.

Table 1
Schedule of Monitoring Activities
Laurel Landfill

Frequency	Item	Duration	Form Used	Notification
Following heavy rains	Landfill Cover Erosion Inspection	Post Closure Period	Annual Cover Inspection Report Form 112001I	Notify city crews to respond, if needed; include in annual report
Monthly	Monitoring Well Static Water Level Readings	April 1993 - March 1994	Site Log Book	None; include data in annual report.
Semi-Annually	Inspection of Monitoring Wells by City of Laurel Personnel	Post Closure Period	Monitoring Well Inspection Report Form, 112002I, and Monitoring Well Inspection Report Form, 112002I	Notify MSWP within 10 days if a well is damaged or destroyed. Repair or replace the well within 90 days unless exception is granted by MSWP. Report well installation details within 90 days or as part of another report.
Semi-Annually or as specified by MSWP May and September	Groundwater Sampling and inspection of monitoring wells by sampling personnel	Post Closure Period	Annual Cover Inspection Report Form 112001I Field Log Book Forms in Appendix C	Notify MSWP within 15 days of determination that an exceedence has occurred. MSWP may require resampling or other actions. Otherwise, report sampling results and groundwater data within 90 days and include in annual report. Sampling personnel notifies City of Laurel if well is damaged.
Annually	Landfill Cover Inspection	Post Closure Period	Annual Cover Inspection Report Form 112001I	Notify city crews to respond, if needed; include in annual report
Annually December	Report results of all groundwater activities to MSWP	Post Closure Period	All data	Annual report to MSWP
As Needed	Repair, rehabilitation, of replacement of damaged or non-functioning monitoring wells, fencing, or other items	Post Closure Period	Repair Record Form 112003R	Notify MSWP within 14 days if a well is damaged or destroyed. Repair or replace the well within 90 days unless exception is granted by MSWP. Report well installation details within 90 days or as part of another report.
Ten-year Cycle	Revision of Groundwater Monitoring Plan	Post Closure Period	All forms re-evaluated	Obtain approval of MSWP


NORTH
KALISPELL
CUT BANK
HAVRE
GLASGOW
SIDNEY
GREAT FALLS
MISSOULA
GLENDIVE
HELENA
LEWISTOWN
MILES CITY
BUTTE
BOZEMAN
SITE LOCATION
BILLINGS
LAUREL
DILLON
MONTANA
R24E
T1S
3748
3700
TRAIL
ROAD
3600
Spring
3551
3585
3535
SITE
3637
33
3515
34
LAUREL MUNICIPAL AIR
3480
3500
3468
3446
DITC
COVE
Laurel Cemetery
3559
SCALE 1:24000
1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

GEO
RESEARCH

FIGURE 1

VICINITY MAP
CITY OF LAUREL LANDFILL
LAUREL, MONTANA

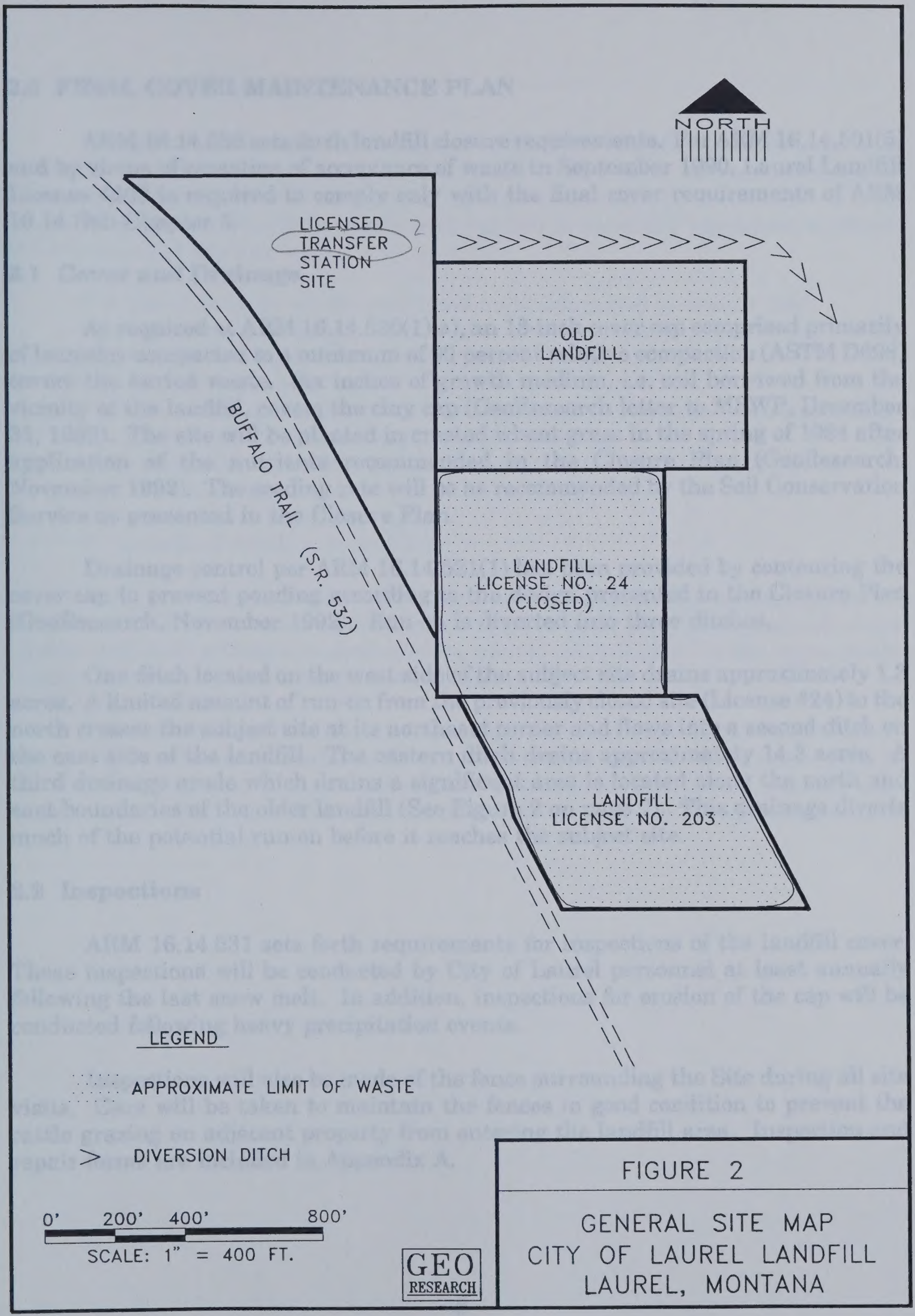

NORTH
LICENSED
TRANSFER
STATION
SITE
2
OLD
LANDFILL
BUFFALO TRAIL (S.R. 532)
LANDFILL
LICENSE NO. 24
(CLOSED)
LANDFILL
LICENSE NO. 203
LEGEND
APPROXIMATE LIMIT OF WASTE
> DIVERSION DITCH
0'
200'
400'
800'
SCALE: 1" = 400 FT.
GEO RESEARCH

FIGURE 2

GENERAL SITE MAP
CITY OF LAUREL LANDFILL
LAUREL, MONTANA

2.0 FINAL COVER MAINTENANCE PLAN

ARM 16.14.530 sets forth landfill closure requirements. Per ARM 16.14.501(5) and by virtue of cessation of acceptance of waste in September 1990, Laurel Landfill License #203 is required to comply only with the final cover requirements of ARM 16.14 Sub-Chapter 5.

2.1 Cover and Drainage

As required at ARM 16.14.530(1)(a), an 18-inch cover cap comprised primarily of lean clay compacted to a minimum of 90 percent relative compaction (ASTM D698) covers the buried waste. Six inches of growth medium, i.e. soil borrowed from the vicinity of the landfill, covers the clay cap (GeoResearch letter to MSWP, December 31, 1992). The site will be planted in crested wheat grass in the spring of 1994 after application of the nutrients recommended in the Closure Plan (GeoResearch, November 1992). The seeding rate will be as recommended by the Soil Conservation Service as presented in the Closure Plan.

Drainage control per ARM 16.14.521(1) has been provided by contouring the cover cap to prevent ponding according to the design presented in the Closure Plan (GeoResearch, November 1992). Run-on is diverted into three ditches.

One ditch located on the west side of the subject site drains approximately 1.3 acres. A limited amount of run-on from the previously closed site (License #24) to the north crosses the subject site at its northeast corner and flows into a second ditch on the east side of the landfill. The eastern ditch drains approximately 14.3 acres. A third drainage swale which drains a significant area is located along the north and east boundaries of the older landfill (See Figure 2 on page 7). This drainage diverts much of the potential run-on before it reaches the subject site.

2.2 Inspections

ARM 16.14.531 sets forth requirements for inspections of the landfill cover. These inspections will be conducted by City of Laurel personnel at least annually following the last snow melt. In addition, inspections for erosion of the cap will be conducted following heavy precipitation events.

Inspections will also be made of the fence surrounding the Site during all site visits. Care will be taken to maintain the fences in good condition to prevent the cattle grazing on adjacent property from entering the landfill area. Inspection and repair forms are included in Appendix A.

2.3 Maintenance Activities

Two growing seasons will be required to allow vegetation to become well established. Until that time, the growth medium and cover cap are particularly vulnerable to erosion and the growth of weeds. Once the vegetation is well established, the site should be stable with regards to potential vegetation washout, soil erosion, and weed growth.

The closed landfill will be monitored and maintained to ensure that:

- vegetation is healthy;
- washed out vegetation is replanted;
- the cap remains in tact;
- differential settling of the cap is repaired and vegetation re-established;
- on-site and off-site drainage remains positive;
- erosion damage to the cap or ditches is repaired and vegetation re-established;
- site access is controlled; and,
- growth of weeds is controlled.

Table 2 on page 10 provides the appropriate maintenance response actions for problems which may be encountered concerning the final cover. Progressively more intense response actions are presented to permit the selection of the appropriate response based on the severity of the problem.

The closed site will be inspected annually and after major rain events to check for possible problems. A checklist, Form 112001I, to be used for these inspections is provided in Appendix A. Any repairs will be documented on Form 112003I, also found in Appendix A, and all documentation will be retained in the operating record.

Table 2
Final Cover Maintenance Response Actions
Laurel Landfill

Problem	Maintenance Response Action
Erosion	Revegetation Application of mulch and revegetation Regrading and revegetation Application of geotextile and revegetation
Negative drainage	Clear ditch of accumulated debris or sediment
Uncontrolled access	Close gate Replace lock Repair fence and/or gate
Weeds	Cut weeds prior to seed development Apply herbicide
Noxious weeds	Apply herbicide twice annually until weed growth is adequately controlled

3.0 GROUNDWATER MONITORING PLAN

ARM 16.14 Sub-Chapter 7 presents specific requirements for a Groundwater Monitoring Plan. The network of groundwater monitoring wells was established during the Hydrogeological and Soils Study required at ARM 16.14.703 which was conducted at the Laurel Landfill in 1992 and 1993. The wells will be sampled for MSWP Table 1 and Table 2 constituents on a regular basis according to the Sampling Plan included in Section 4.0 and the QA/QC Plan in Section 5.0 of this document.

3.1 Reporting Requirements

As required at ARM 16.14.707, a report describing all groundwater sampling, water level measurements, direction and rate of groundwater flow, and a statistical evaluation of groundwater quality data will be submitted to MSWP within at least 90 days of each sampling event. Modifications to the monitoring well network, inspections, and maintenance and construction activities, as well as all groundwater sampling information, at the Laurel Landfill License #203 site will be submitted to the MSWP in an annual report.

According to ARM 16.14.706(14), an evaluation of each sampling event will include a determination whether there is a statistically significant increase over background concentrations and general parameter values for each constituent and parameter analyzed. The evaluation must be completed within 15 days of completion of sampling and analysis.

The MSWP must be notified within 15 days of receipt of analytical results if a significant increase in concentrations over background values has occurred. Otherwise, a report of the sampling results and static water elevation data must be submitted within 90 day after sampling. The report will describe any deviations from the approved sampling plan or analytical procedures.

Per ARM 16.14.706(15), copies of all reports and all Site Log Books and Field Log Books must be present in the operating record for the Laurel Landfill. The field records must be available for MSWP and public inspections upon request. Field Log Books are comprised of detailed forms which demonstrate that the Sampling Plan and QA/QC Plan have been followed.

3.2 Statistical Evaluation of Groundwater Data

Statistical evaluation of groundwater data will be conducted according to procedures presented in ARM 16.14.706(10-13). Upon the acquisition of four or more independent water quality data sets from the background well and each of the downgradient wells at the Laurel Landfill, a statistical evaluation of the concentration of each constituent for which data is available will be included in each

1,

report. The parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination will be used at the Laurel Landfill. The evaluation will include estimation and testing of the contrasts between each compliance well's mean and the mean level in the background well for each analyte. This procedure will be used for all constituents for detection monitoring and those required for assessment monitoring at Laurel Landfill. See Section 4.4.4 for a discussion of detection and assessment monitoring at Laurel Landfill.

The selected statistical evaluation procedure is applicable unless and until further data becomes available which indicates that the distribution of chemical parameters or hazardous constituents is not appropriate to normal distribution theory. If necessary, data transformation or an alternative distribution theory test will be applied to the data. The appropriate transformation(s) or test(s) will be determined after examination of the data which does not conform to a normal distribution.

The Type I experiment wise error rate for each testing period will be at the 0.05 significance level for the multiple comparisons procedure and at the 0.01 significance level for individual well comparisons.

Constituent concentrations reported as less than the practical quantitation level (PQL) will be assigned a value of one-half the Method Detection Limit (MDL) or one-twentieth of the PQL if no MDL value is available. Concentrations of constituents reported to be present but at less than the PQL will be assigned a value equal to the median of the PQL and the MDL.

3.3 Monitoring Well Network

The monitoring well network at the closed Laurel Landfill (License #203) has been established in compliance with ARM 16.14.704. The monitoring network includes one background well, MW-4, and downgradient wells MW-1, MW-2, MW-3, and 93MW-2 (See Figure 3 on page 16). The sufficiency of one background well at the Laurel Landfill has been demonstrated by the consistent analytical results obtained from the three sampling events which have been conducted since the wells were installed in October 1992. Locations of these five wells at the Laurel Landfill have been previously approved by MSWP.

3.4 Well Completion

All wells at the Laurel Landfill have been completed in compliance with ARM 16.14.705. Well completion logs are included in Appendix B. Details of well installation and construction are also available in the status update and the final

Hydrogeological and Soils Study Report (GeoResearch, 1992 and GeoResearch, 1994 in progress).

The wells are two-inch diameter wells constructed of flush threaded Schedule 40 polyvinyl chloride (PVC) casing with 0.02-inch slotted screen and blank sections. Upon installation, each monitoring well is cased and completed in a manner which maintains the integrity of the monitoring bore hole. The annular space between the bore hole and the screened portion of the well casing is filled with 10-20 mesh silica sand to a depth of approximately one foot above the screen to enable collection of groundwater samples. The annular space above the screened portion is sealed with grout or bentonite chips. In wells MW-1 and MW-2 bentonite chips were placed to a depth of three feet from the surface and concrete was place to ground level. In wells MW-3 and MW-4, three feet of Portland cement with three percent bentonite was tremied into the annulus space over the sand to a depth of three feet below ground surface and concrete was placed to ground level. In well 93MW-2D dry bentonite chips were placed to the surface with two seven-foot hydrated bentonite seals at 42 and 22 feet below ground surface. Six-inch diameter steel well protectors with locking caps were set to a depth of three feet and concrete seals and pads were poured around the protectors at MW-1, -2, -3, and -4. PVC slip caps were placed on top of the risers inside the locked steel protectors.

3.5 Monitoring Well Network Maintenance

3.5.1 Inspections

Monitoring well inspections will be conducted and the results reported as required at ARM 16.14.715. Each well within the network will be inspected at least semi-annually. In addition, groundwater sampling personnel will inspect each well whenever sampling or monitoring activities are conducted at the site. The wells will be inspected for integrity of the locking cap, padlock, steel well protector, PVC well casing riser and cap, and the surface concrete pad.

Any unexplainable foreign material removed from the well during purging or sampling activities will constitute a suggestion of a breach of integrity of the monitoring well. As much as possible, an explanation for the presence of the foreign material will be determined and a recommendation for continued use of the well or its replacement will be provided.

The Monitoring Well Inspection Report Form (112002I) found in Appendix A will be completed for each inspection event. Details of any breach of integrity will be documented on the Field Observations Form 112104F which is found in Appendix C. The completed forms will be included in the annual report of groundwater monitoring activities.

3.5.2 Inspection Reports

Any breach of integrity observed by the groundwater sampling personnel will be reported to the City of Laurel within 24 hours of discovery.

If for any reason a well is destroyed or otherwise fails to function properly, the City of Laurel will notify the MSWP in writing within ten (10) days of discovery.

All Inspection Report Forms, Field Observation Forms, and Repair Report Forms will be retained in the landfill operating record.

3.5.3 Monitoring Well Maintenance Procedures

Measuring points for water level measurements and static water elevations are indicated with black waterproof ink on top of the riser casing. The indicated measuring points on each well riser will be reinforced as the marks begin to fade.

If the well continues to function properly, a breach of integrity will be repaired by the City of Laurel within thirty days of discovery. If the damage cannot be repaired, the well will be properly abandoned and replaced within 90 days unless otherwise approved in writing by the MSWP. If for any reason monitoring is permanently discontinued at a well, that well will be properly abandon.

3.5.3.1 Abandonment

Wells which have failed to function properly and cannot be repaired will be completely sealed with grout or bentonite in order to prevent future contamination of groundwater. Abandonment procedures are presented at ARM 16.14.713, ARM 36.21.671-673 and ARM 36.21.810. If possible, the well casings and screens will be removed and the borehole filled with grout or concrete from the bottom of the constructed well to within approximately three feet of ground level as the casing and screen are removed. The last three feet will be filled with naturally occurring soils.

A water well log report fully describing all abandonment procedures should be submitted to the Montana Department of Natural Resources and Conservation within 90 days of the abandonment activity. The required MDNRC form is included in Appendix B.

3.5.3.2 Installation of Replacement Wells

A replacement well will be installed at a location which allows it to fulfill the intended purpose of the well it is replacing. It will be installed and completed as specified in ARM 16.14.705 and ARM 36.21.801-808. The exact location will be determined by the City of Laurel in accordance with ARM 16.14.704 and will be

subject to MSWP approval. All downgradient wells will be located within 150 meters (490 feet) of the nearest waste disposal area and on land previously included within the original license, the relevant point of compliance (RPOC) per ARM 16.14.708(1)(f). An alternative RPOC may be specified by MSWP.

All replacement network wells will be installed by a monitoring well constructor licensed in the State of Montana and in accordance with specifications presented in ARM 36.21.801-36.21.808 and ARM 16.14.705. A groundwater specialist who has demonstrated competency to the MSWP will also be on site during the installation of all wells to describe and classify the well cuttings.

The replacement well will be developed and sampled upon installation. Following the initial sampling event, the well will be sampled on the established schedule for the groundwater monitoring network.

3.5.3.3 Documentation of Well Construction

If a major plan or report including the annual report of groundwater monitoring activities is in preparation at the time of new well construction or rehabilitation, the lithologic log, well construction logs, and other well construction and development details will be attached as an appendix to the major document per ARM 16.14.707. Otherwise, replacement well construction documentation will be submitted to the MSWP within 90 days per ARM 16.14.715.

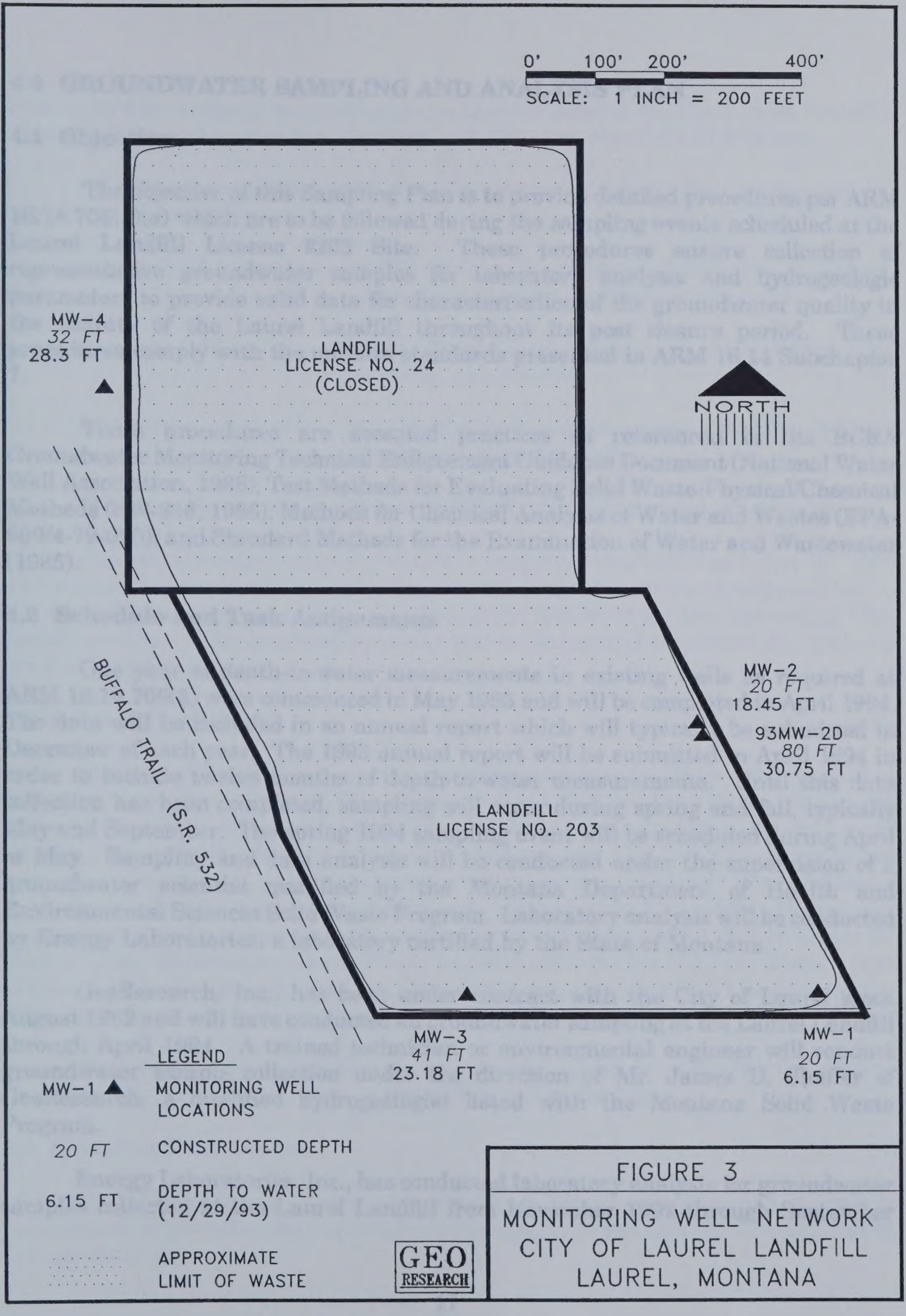

0'
100'
200'
400'
SCALE: 1 INCH = 200 FEET
LANDFILL
LICENSE NO. 24
(CLOSED)
NORTH
MW-4
32 FT
28.3 FT
BUFFALO TRAIL (S.R. 532)
MW-2
20 FT
18.45 FT
93MW-2D
80 FT
30.75 FT
LANDFILL
LICENSE NO. 203
MW-3
41 FT
23.18 FT
MW-1
20 FT
6.15 FT
LEGEND
MW-1 ▲ MONITORING WELL LOCATIONS
20 FT CONSTRUCTED DEPTH
6.15 FT DEPTH TO WATER (12/29/93)
APPROXIMATE LIMIT OF WASTE
GEO RESEARCH

FIGURE 3
MONITORING WELL NETWORK
CITY OF LAUREL LANDFILL
LAUREL, MONTANA

4.0 GROUNDWATER SAMPLING AND ANALYSIS PLAN

4.1 Objective

The objective of this Sampling Plan is to provide detailed procedures per ARM 16.14.706(1)(a) which are to be followed during the sampling events scheduled at the Laurel Landfill License #203 Site. These procedures ensure collection of representative groundwater samples for laboratory analysis and hydrogeologic parameters to provide valid data for characterization of the groundwater quality in the vicinity of the Laurel Landfill throughout its post closure period. These procedures comply with the uniform standards presented in ARM 16.14 Subchapter 7.

These procedures are accepted practices as referenced in the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (National Water Well Association, 1986); Test Methods for Evaluating Solid Waste-Physical/Chemical Methods (SW-846, 1986); Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020); and Standard Methods for the Examination of Water and Wastewater (1985).

4.2 Schedule and Task Assignments

One year of depth-to-water measurements in existing wells as required at ARM 16.14.706(3) were commenced in May 1993 and will be completed in April 1994. The data will be included in an annual report which will typically be submitted in December of each year. The 1993 annual report will be submitted in April 1994 in order to include twelve months of depth-to-water measurements. Until this data collection has been completed, sampling will occur during spring and fall, typically May and September. The spring 1994 sampling event will be scheduled during April or May. Sampling and data analysis will be conducted under the supervision of a groundwater scientist qualified by the Montana Department of Health and Environmental Sciences Solid Waste Program. Laboratory analysis will be conducted by Energy Laboratories, a laboratory certified by the State of Montana.

GeoResearch, Inc., has been under contract with the City of Laurel since August 1992 and will have conducted all groundwater sampling at the Laurel Landfill through April 1994. A trained technician or environmental engineer will conduct groundwater sample collection under the direction of Mr. James D. Shaffer of GeoResearch, a qualified hydrogeologist listed with the Montana Solid Waste Program.

Energy Laboratories, Inc., has conducted laboratory analysis for groundwater samples collected at the Laurel Landfill from November 1992 through September

1993 and will continue to analyze groundwater samples for the Laurel Landfill. Energy Laboratories is certified by Region 8 EPA and the State of Montana.

Based on current information, the following sampling schedule is recommended at the Laurel Landfill:

Spring 1994	•	MSWP Table 2 analytes plus Table 1 anions, general parameters, and iron at all wells;
Summer 1994	•	MSWP Table 2 analytes detected during Spring 1994 sampling at all wells;
Fall 1994	•	MSWP Table 1 analytes plus detected Table 2 analytes at all wells; and,
Winter 1994	•	Detected MSWP Table 2 analytes at all wells.

The recommended sampling schedule frequency and list of analytes for 1995 and subsequent years will be determined by an evaluation of the data presented in the 1994 Hydrogeologic and Soils report and the results of at least the spring 1994 sampling event. The proposed schedule will be submitted to MSWP for approval prior to its initiation.

4.3 Access Procedures

The Laurel Landfill is located on property owned by the State of Montana and leased from the Department of State Lands under a Right-of-Way lease. Monitoring wells MW-1, MW-2, MW-3 and 93MW-2 are located on property leased for the Laurel Landfill license #203. As long as the City of Laurel has Right-of-Way access to the property, no additional access agreements are necessary. If at any time additional wells are required outside the Landfill license #203 area, or if the right-of-way lease is not maintained, a Land Use License for Section 33, Township 1 South, Range 24 East, P.M.M., Yellowstone County must be obtained from the Montana Department of State Lands Southern Area Office. Stipulations in the Land Use License must be adhered to by the City of Laurel and by sampling personnel.

The upgradient well, MW-4, is on property which is owned by the City of Laurel and is currently in use as a Solid Waste Transfer Site.

4.4 Sampling Procedures

The materials and procedures described herein are designed to obtain representative groundwater samples from the aquifer(s) beneath the Laurel Landfill License #203 site.

Depth-to-water (static water level) measurements will be collected twice during each sampling event in order to comply with ARM 14.16.706(5). Prior to any sampling activities, the depth to water will be measured in each well at the Laurel Landfill. The water level probe will be decontaminated before being place into each well. This will allow the calculation of static water elevations for approximately the same moment in time. The same measurements will be repeated as the initial sampling step following equipment decontamination procedures at each well.

4.4.1 Sample Acquisition Methods

Care must be taken at each step associated with the preparation for sampling, sample collection, and care of the sample following acquisition to assure that a representative groundwater sample has been delivered to the laboratory for analysis. Sampling steps required at each well include:

- Transport all appropriate equipment to the sampling site;
- Decontaminate equipment;
- Calibrate equipment;
- Inspect well;
- Determine static water height;
- Calculate water column volume;
- Don new disposable gloves;
- Evacuate well;
- Withdraw sample;
- Field filter as required;
- Containerize/preserve sample aliquots;
- Measure field parameters.

4.4.1.1 Transport of All Appropriate Equipment

It is critical that all appropriate equipment be at the sampling location when sampling commences. A checklist of appropriate equipment for sampling at the Laurel Landfill is presented on Table 9, page 47. A check list of the same equipment is provided in each Field Log Book. During transportation and use, the equipment should be protected from rain and excessive heat, motion, or impacts. The condition and operability of each piece of equipment and instrumentation will be examined prior to transport to the field.

The appropriate sample bottles and preservatives will be obtained from Energy Laboratories immediately prior to each sampling event to assure cleanliness of bottles and correct quantities of preservatives.

4.4.1.2 Equipment Preparation

Care must be taken to place only clean equipment into a groundwater monitoring well to avoid cross-contaminations of wells and sites and to assure collection of a groundwater sample representative of the aquifer under the Site. Field instruments must be calibrated prior to use to provide accurate determination of field parameters. Decontamination procedures are presented in Section 5.1.1.2 of this report and calibration procedures are presented in Section 5.1.4. Calibration results are documented on forms 112206C, 112207C, 112208C, and 112209C.

The well probe and the temperature sensors are calibrated prior to going to the field. The specific conductivity and pH meters are calibrated in the field. Calibrations are performed at least twice per sampling event, at the beginning and the end of the event; the pH meter is calibrated with one standard at least every two hours.

4.4.1.3 Well Inspection

In accordance with Section 3.5, the protective casing will be examined from all perspectives to determine if damage has occurred. The padlock and cap will be inspected then removed. The riser casing and cap will be inspected for damage. Observed odors will be noted and the total depth of the well will be measured. Detailed notes of any damage ascertained will be placed on the Well Inspection Form in the Field Log Book. Damage will be reported to the City of Laurel Director of Public Works within 24 hours of its discovery.

4.4.1.4 Determine Static Water Height

The well identification on the well casing and inside the locking cap is noted as the sample location in the Field Log Book. The PVC slip cap is removed and the decontaminated water level meter probe is inserted into the riser approximately one foot. The water level meter is powered and tested for both auditory and visual response.

The probe is lowered into the well. Sampling personnel must maintain control over the dropping probe at all times. As the probe approaches the water level depth which has been measured in the well on previous occasions, the rate of drop of the probe is slowed to enable measurement of the depth to water without submerging the tape section of the water level meter.

The static water height (SWH) is calculated by measuring the depth to water (MWLD) and the total depth of the well (MWD). Both measurements are made from the measuring point (MP) indicated on the top of the riser casing in permanent black ink.

The current water level depth (MWLD) is measured to within 0.01 feet and is compared to previously measured values for reasonableness. If the current measurement differs from the previous measurements, a second measurement must be made for confirmation. The measured water level depth is recorded on the Well Purging and Sampling Information Form 112311S in the Field Log Book to the nearest 0.01 foot.

The total depth of the well (MWD) is measured using the well probe as a sounding device. The meter response signals are disabled and the probe is lowered to the bottom of the well which is sensed by a decrease in the weight of the probe. Care is taken to determine the point at which the probe just contacts the bottom of the well without any slack in the tape. The total depth of the well is measured from the same measuring point used for the depth-to-water measurement. The current total depth is measured to within 0.01 feet and is compared to the constructed depth for reasonableness. If the current measurement differs from the original value, a second measurement must be made for confirmation. The measured total depth is recorded on the Well Purging and Sampling Information Form in the Field Log Book to the nearest 0.01 foot.

The static water height (SWH) is calculated according to Equation 1.

$$\mathrm{SWH} = \mathrm{MWD} - \mathrm{MWLD} \tag{1}$$

4.4.1.5 Well Evacuation

The objective of this Sampling Plan is to collect a sample of groundwater which is representative of the aquifer underlying the site. It is possible for water which stands in the PVC well casing to undergo physical and chemical changes. Standing water must be removed immediately prior to sample collection to assure collection of a sample representative of the aquifer. Three times the volume of standing water contained in the riser is the accepted amount of water to be removed to provide representative groundwater for sample collection and analysis.

The volume of the water column (WWV) in the wells is calculated using Equation 2. The length of the water column (SWH) is determined using Equation 1.

$$\mathrm{WWV, (gal)} = \mathrm{SWH, (ft)} \times 0.163\,\frac{\mathrm{gal/ft}}{\mathrm{in}^2} \times \left(\frac{\mathrm{welldiameter\,(in)}}{2}\right)^2 \tag{2}$$

A minimum of three water column volumes will be purged from the well casing prior to sample withdrawal unless the well is purged dry prior to removing the three

volumes. These calculations and the actual amount of water removed from the well will be noted on the Well Purging and Sampling Information Form, 112311S, in the Field Log Book.

4.4.1.6 Sample Numbering System

Samples will be labeled with a nine character sample identification number, eg. LAU993001. The first three characters designate the project: LAU for Laurel Landfill; the second three characters are numbers (or one letter and two numbers, eg. N92) to designate the month and year of sampling; the final three characters will be numbers. The final three characters designate the order in which the samples are collected, beginning with 001 for each semi-annual sampling event. Information cross referencing sample numbers and the sample location by well will be available on the Well Purging and Sampling Information Form. A table of the cross reference numbers and well identifications will be provided in the Site Log Book and in all reports which include the laboratory results.

4.4.1.7 Sample Withdrawal and Containerization

The representative sample of groundwater will be acquired using hand bailers following well evacuation. To reduce the potential for cross-contamination between wells, new disposable gloves will be used at each well. The use of both a stainless steel bailer and a PVC bailer are required to collect the full suite of MSWP Table 1 and Table 2 analytes. The sample withdrawal procedure includes:

- Triple rinse each decontaminated bailer by discarding the first three bailer volumes removed from the well;
- Use bailers, containers, and preservatives for each sample aliquot as shown in Tables 3 and 4 on pages 29 and 30 in Section 4.0; and
- Label each sample container just prior to filling with:

    - Consulting Company Name GeoResearch, Inc.;
    - Location Laurel Landfill and Sample Number;
    - Date and Time month/day/year and military time;
    - Preservative per aliquot, see Tables 3 and 4 in Section 4.0; and,
    - Sample aliquot, See Tables 3 and 4 in Section 4.0.

- Withdraw aliquots of groundwater in the appropriate volumes for the five sample aliquots shown and in the order shown in Tables 3 and 4 on pages 29 and 30;
- Add the appropriate preservative to the sample bottle immediately prior to placing the sample aliquot into the container;
- Field filter the dissolved metals aliquot before placing it into the container; and,
- Check all sample bottle caps for tightness.

4.4.1.8 Field Filtration

The sample aliquot which is analyzed for dissolved metals is filtered before it is placed into its container. The glass filter apparatus is washed according to procedures in Section 5.1.1.2. The following steps constitute field filtration:

- The clean apparatus is triple rinsed with 10 ml of sample water;
- The catch flask is rinsed and emptied after each 10 ml aliquot;
- Place approximately 260 ml of sample in the funnel;
- Apply a vacuum of 15 to 30 pounds per square inch gauge to catch flask using hand vacuum pump; and,
- Carefully pour filtered sample aliquot into the appropriate bottle (preserve with HNO_3).

4.4.1.9 Field Parameter Measurement

Field parameters will be measured as required at ARM 16.14.706(7). Prior to any field parameter measurements, the Orion Model 230A portable pH meter and the YSI Model 33 S-C-T meter are calibrated according to their calibration procedures presented in Section 5.1.4. The calibrations are documented in the Field Log Book on the appropriate forms. The calibrated pH meter temperature sensor is used to measure field temperature. Following collection of all sample aliquots, the PVC bailer is used to collect approximately 500 mL of water which is place into a decontaminated wide mouth glass jar. The pH and specific conductivity probes are place into the collected sample. The pH probe is inserted so that the junction in the pH meter is below the water level, but the uncovered fill hole remains above the water level at all times. The temperature sensor on the specific conductivity probe is placed below the water level and the conductivity meter is placed in the temperature mode. The probes are allowed to acclimate to the sample.

The following activities are conducted in the order presented below. Values are recorded on the Well Purging and Sampling Information Form 112311S;

1) The field temperature of the sample is read on the pH meter as soon as it shows a stabilized temperature reading;

2) The pH is read and the value noted as soon as a stabilized value is reached. The meter signals that the electronic signal has stabilized by flashing and emitting a beep;

3) When the needle has stabilized, the temperature in degrees Celsius is read from the S-C-T meter temperature scale which reads from right to left; and

4) The S-C-T meter is placed in the specific conductivity mode by selecting the X100 scale. If the reading is below 50 on the 0 to 500 range, place the meter in the X10 scale. If the reading is still below 50, switch to the X1 scale. The value as read from the meter conductivity scale and the appropriate scale factor are noted. This measurement is not temperature compensated.

4.4.1.10 Collect Well Recharge Data

The rate of recharge in each well subsequent to sampling is determined in order to calculate the rate of groundwater flow and is reported with the sampling results pursuant to ARM 16.14.706(4)(a). The water level as it rises subsequent to sampling is recorded with the time the reading is obtained. Four readings approximately 30 seconds apart are recorded on the Well Purging and Sampling Information Form 112311S in the Field Log Book.

4.4.2 Sampling Locations

Figure 2 on page 7 presents a site map which shows the locations of the groundwater monitoring network for Laurel Landfill License #203. The identifying designations and general locations of the five wells which comprise the monitoring network on the Laurel Landfill License #203 are:

ID Number	Location
MW-1	approximately 90 feet west of the southeast corner
MW-2	near the center of the east side
93MW-2D	approximately 20 feet south of MW-2
MW-3	approximately 150 feet east of the southwest corner
MW-4	approximately 20 feet north of the entrance gate to the transfer site

4.4.3 Order of Sample Collection

The proper order of sample collection by well location and by analyte aliquot is important to provide assurance of representativeness of each sample. The order wells are sampled is determined by the cleanliness or purity of each. Sampling is initiated at the cleanest well and moves toward the well exhibiting the highest level of contamination as observed in previous sampling events. This approach is followed to reduce the potential for possible cross-contaminating effects between the successively sampled wells. The order of collection by analyte aliquot is determined by the volatility of the analytes and the type of bailer to be used. The aliquot containing the most volatile analytes is collected first using the stainless steel bailer.

All aliquots collected with the stainless steel bailer are collected prior to those collected with the PVC bailer.

4.4.3.1 Order of Collection by Location

The wells will be sampled in the order of expected increasing concentrations of volatile constituents. Sampling will begin with the upgradient well, MW-4, north of the License area #203, and proceed counter clockwise around the site ending with MW-2. The order of sampling by location or well ID number is:

Order of Sampling	Well ID Number
1	MW-4
2	MW-3
3	MW-1
4	93MW-2D
5	MW-2

4.4.3.2 Order of Collection by Parameter

The most volatile sample aliquot is collected first using the stainless steel bailer followed by the other aliquots collected with the stainless steel bailer. The PVC bailer is then triple rinsed with sample and used to collect the remaining aliquots. Sample aliquots at each well are collected in the following order which is the same as the order in Tables 3 and 4 on pages 29 and 30.

Sampling Order	Detection Monitoring	Assessment Monitoring
1	Volatile Organics	Volatile Organics
2	Nitrate and COD	Semi-volatiles, PCBs, pesticides, herbicides
3	Cyanide	Cyanide
4	Major anions and General Parameters	Sulfide
5	Dissolved Metals (field filtered)	Dissolved Metal (field filtered)

4.4.4 Sampling Objectives

Two types of sampling will occur at the Laurel Landfill, one is detection monitoring and the other is assessment monitoring. Detection monitoring is intended to detect the presence of indicator constituents which may indicate the presence of additional groundwater contaminants. Assessment monitoring is intended to determine the nature and extent of contamination whenever it is encountered during detection monitoring. Overlapping lists of analytes are required for the two types of monitoring. Lists of specific analytes are included in Tables 5 and 6 on pages 31 and

34. Because volatile organics have been observed in MW-2, assessment monitoring is triggered at the Laurel Landfill.

Exceedence of enforcement standards will be determined statistically using a parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to examine the difference in the mean concentrations of each constituent between the upgradient well and each of the downgradient wells. The ANOVA will be performed at a significance level of 5 percent maintaining 1 percent significance level for comparison of the individual wells. Section 3.2 provides additional information on ANOVA methodology.

4.4.4.1 Detection Monitoring

Detection monitoring includes sampling each well for analysis of MSWP Table 1 constituents semi-annually at high and low groundwater periods, at least three months apart per ARM 16.14.706(4). Because Table 1 constituents have been detected in downgradient well MW-2 at Laurel Landfill in concentrations exceeding those in the background well MW-4, assessment monitoring is triggered.

4.4.4.2 Assessment Monitoring

All wells must be sampled for MSWP Table 2 constituents, collecting at least one sample from each of the wells. For any constituent detected in the downgradient wells during analysis for the complete MSWP Table 2 list, three additional independent samples must be collected from each well, both upgradient and downgradient, for analysis of the detected constituents.

Ongoing assessment monitoring includes semi-annual detection monitoring comprised of all MSWP Table 1 constituents plus any detected MSWP Table 2 constituents at each well plus one full MSWP Table 2 analysis at least annually from both upgradient and downgradient wells unless the schedule is modified by MSWP.

The above described detection monitoring must continue for the 30 year post closure period and assessment monitoring must continue until all Table 2 constituents are shown to be at or below background levels for two consecutive semi-annual sampling events (ARM 16.14.708(2)), or until the MSWP program approves a modified sampling network and/or sampling schedule.

4.4.5 QA/QC Samples

QA/QC samples will be preserved and assigned ID numbers consistent with natural groundwater samples. Three QA/QC samples will be collected in the field:

- one field blank of distilled water per 10 gallons of water, analyzed for VOCs;
- one duplicate natural ground water sample per 10 or fewer natural samples, analyzed for full suite of analytes; and,
- an equipment rinsate sample per sampling event, analyzed for full suite of analytes.
- in addition, one trip blank prepared by the laboratory per sampling event, analyzed for VOCs;

The trip blank will be sealed when obtained from the laboratory and will not be opened by sampling personnel. The field blank will consist of a composite of all one-gallon jugs of distilled water planned to be used for equipment decontamination purposes during each sampling event. If additional distilled water must be obtained, another field blank of the additional distilled water will be prepared and analyzed. The field blank will be analyzed for VOCs only.

The duplicate sample will be collected simultaneously with the original sample collection at a contaminated well, typically MW-2. Field parameters measured will be recorded for both the original sample and the duplicate sample.

The equipment rinsate blank will be collected following decontamination procedures at the final well to be sampled during the sampling event; this will be the most highly contaminated well. After the third decontaminating rinse, additional rinsate water will be poured into and over the bailer and collected in a decontaminated container. Rinsate aliquots analyzed for those analytes collected with the stainless steel bailer (See Tables 3 and 4 on pages 29 and 30) will consist of distilled water collected in a glass container. Those collected with the PVC bailer will consist of deionized water collected in a glass container. Equipment decontamination procedures are discussed in Section 5.1.1.2.

4.4.6 Shipping and Handling

The proximity of the Laurel Landfill to the analytical laboratory permits hand delivery of the samples within 24 hours of sample collection. Arrangements will be made by sampling personnel to deliver the samples on the day of sampling if possible. Sampling personnel will retain custody of the samples or assure their integrity between the time of collection and delivery to the analytical laboratory through the use of custody seals. Any transfer of custody will be recorded on the chain-of-custody record. Chain-of-custody and custody seal procedures are presented in Section 5.0.

4.4.7 Notification of Sampling Activities

Per ARM 16.14.706(1)(a)(iv), Montana Solid Waste Program (MSWP) personnel will be notified by telephone of impending groundwater sampling activities two to

three days in advance of the planned sampling event. This notification is intended to allow MSWP to obtain split samples and/or to observe the sampling event.

4.4.8 Analytical Parameters

Two sets of analytical parameters must be considered at Laurel Landfill: MSWP Table 1 analytes for detection monitoring; and MSWP Table 2 analytes for assessment monitoring. MSWP Table 1 and Table 2 analytes and their EPA analytical method numbers, practical quantitation limits, and method detection limits are presented in Tables 5 and 6 respectively on pages 31 and 34.

Method detection limits (MDLs) are calculated annually at Energy Laboratories for each applicable analytical instrument and procedure. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. It is based on a specific, well defined analytical method and is calculated from the results of seven or more replicate analyses of samples with analyte levels at or near the detection limit of the method. Typically MDLs are calculated using prepared samples in a relatively clean matrix. Instrument detection limits (IDLs) are similar to MDLs but are based on instrument detection limits independent of the method used to prepare the extract. Actual IDLs and MDLs may increase due to interferences found in samples and sample extracts. When MDLs are limited by analytical instrument sensitivity, IDLs are used to estimate MDLs. In Tables 5 and 6 MDLs which are estimated from IDLs assume sample preparation extraction efficiencies of 100 percent and no matrix interference effects.

Energy Laboratories generates QA/QC samples as required by each EPA method. Table 7 on page 45 describes the types of QA/QC typically analyzed, and Table 8 on page 46 presents the specific QA/QC samples required by each method. QA/QC samples are included with the run of natural samples at a rate of one in ten. Laboratory results reported for each individual sampling event results include the QA/QC samples included with the analysis of those natural samples.

A list of necessary sampling equipment and supplies is presented on Table 9 on page 47. This table is used as a checklist when gathering the necessary items for each groundwater sampling event. Sample containers and preservation reagents will be obtained from Energy Laboratories Billings location within one week prior to each sampling event. The integrity of the containers and reagents will be assured by placing them in a cooler which will be sealed until the time of the sampling event. Sample containers, preservation reagents, and holding times for the specific sample aliquots to be collected are presented in Tables 3 and 4 on pages 29 and 30.

Table 3
Summary of MSWP Table 1 Groundwater Sample Aliquots Detection Monitoring

Sample Parameter	Bailer/Filtration	Container	Preservative	Holding Time
1. Volatile Organics[1]	Stainless Steel/ Unfiltered	2 40-ml glass/teflon vials	2 drops HCl to pH < 2 Cool, 4°C	14 days
2. Nitrate, COD	Stainless Steel/ Unfiltered	250 ml plastic	2 ml H_2SO_4 to pH < 2 Cool, 4°C	28 days
3. Cyanide	PVC/Unfiltered	500 ml plastic	2 ml NaOH to pH > 12 Cool, 4°C	14 days
4. Major Anions and General Parameters	PVC/Unfiltered	500 ml plastic	Cool, 4°C	Analyze pH immediately, 28 days for remainder
5. Dissolved Metals	PVC/Filtered	250 ml plastic	2 ml HNO_3 to pH < 2 Cool, 4°C	28 days for Mercury, 6 months for remainder

[1] Take care to slowly pour sample down side of container to avoid degassing.

Table 4
Summary of MSWP Table 2 Groundwater Sample Aliquots
Assessment Monitoring

Sample Parameter	Bailer/Filtration	Container	Preservative	Holding Time
1. Volatile Organics[1]	Stainless Steel/ Unfiltered	2 40-ml glass/teflon vials	2 drops HCl to pH < 2 Cool, 4°C	14 days
2. Semi-volatiles, Pesticides, Herbicides, PCBs, Petroleum Hydrocarbons	Stainless Steel/ Unfiltered	5 1000 ml glass (narrow mouth)	Cool, 4°C	7 days
3. Petroleum Hydrocarbons	Stainless Steel/ Unfiltered	1 1000 ml glass (narrow mouth)	Cool, 4°C	14 days
3. Sulfide	PVC/Unfiltered	250 ml plastic	2 ml zinc acetate Cool, 4°C	7 days
4. Dissolved metals	PVC/Filtered	250 ml plastic	2 ml HNO_3 to pH < 2 Cool, 4°C	28 days for Mercury, 6 months for remainder

[1] Take care to slowly pour sample down side of container to avoid degassing.

Table 5
MSWP Table 1 Methods, PQLs and MDLs
Inorganics, Major Anions, and General Parameters

Analyte	EPA Method	PQL (mg/L or as shown)	MDL (mg/L or as shown)
Antimony*	204.2	0.05	0.003
Arsenic*	206.2	0.005	0.0007
Barium*	200.7	0.1	0.001
Beryllium*	200.7	0.001	0.0003
Cadmium*	200.7	0.001	0.00094
Chromium*	200.7	0.01	0.004
Cobalt8	200.7	0.01	0.002
Copper*	200.7	0.01	0.003
Iron	200.7	0.03	0.002
Lead*	239.2	0.002	0.001
Mercury*	245.2	0.001	0.0001
Nickel*	200.7	0.01	0.009
Selenium*	270.3	0.005	0.0006
Silver*	200.7	0.005	0.004
Thallium*	279.2	0.1	0.001
Vanadium*	200.7	0.10	0.009
Zinc*	200.7	0.01	0.001
Chloride	300.0	1	0.2
Cyanide*	335.3	0.005	0.0015
Nitrate as N	353.2	0.05	0.0089
Sulfate	300.0	1	0.13
Chemical Oxygen Demand	410.1	1	0.1[1]
Specific Conductance	120.1	1 µmho/cm	not available
pH	150.1	0.1 pH units	0.01[1] pH units

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
* also MSWP Table 2 analyte
[1] Instrument Manufacture's specification

Table 5 Continued
MSWP Table 1 PQLs and MDLs
Volatile Organics (Long List) by Method 8260

Analyte*	Chemical Abstracts Service Registry No.	PQL (μg/L or as shown)	MDL (μg/L or as shown)
Acetone	67-64-1	20	1.70
Acrylonitrile	107-13-1	20	1.77
Benzene	71-43-2	1.0	0.07
Bromochloromethane	74-97-5	1.0	0.09
Bromodichloromethane	75-27-4	1.0	0.08
Bromoform	75-25-2	1.0	0.06
Bromomethane	74-83-9	1.0	0.21
Carbon Disulfide	75-15-0	1.0	0.08
Carbon Tetrachloride	56-23-5	1.0	0.18
Chlorobenzene	108-90-7	1.0	0.18
Chloroethane	75-00-3	1.0	0.45
Chloroform	67-66-3	1.0	0.11
Chlorodibromomethane	124-48-1	1.0	0.11
Chloromethane	74-87-3	1.0	0.37
Dibromomethane	74-95-3	1.0	0.11
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	1.0	0.17
1,2-Dibromoethane(EDB)	106-93-4	1.0	0.08
1,2-Dichlorobenzene	95-50-1	1.0	0.06
1,4-Dichlorobenzene	106-46-7	1.0	0.14
Dichlorodifluoromethane[2]	75-71-8	1.0	0.11
trans-1,4-Dichloro-2-butene	110-57-6	1.0	not available
1,1-Dichloroethane	75-34-3	1.0	0.14
1,2-Dichloroethane	107-06-2	1.0	0.05
1,1-Dichloroethene[1]	75-35-4	1.0	0.24

* Also MSWP Table 2 analyte
PQL = Practical Quantitation Limit
MDL = Method Detection Limit
[1] ...ethene = ...ethylene
[2] specific to Laurel Landfill

Table 5 Continued
MSWP Table 1 PQLs and MDLs
Volatile Organics (Long List) by Method 8260, Continued

Analyte*	Chemical Abstracts Service Registry No.	PQL (µg/L or as shown)	MDL (µg/L or as shown)
cis-1,2-Dichloroethene[1]	156-59-2	1.0	0.14
trans-1,2-Dichloroethene[1]	156-60-5	1.0	0.14
1,2 Dichloropropane	78-87-5	1.0	0.11
cis-1,3-Dichloropropene	10061-01-5	1.0	0.07
trans-1,3-Dichloropropene	10061-02-6	1.0	0.06
Ethylbenzene	100-41-4	1.0	0.13
2-Hexanone	591-78-6	20	1.62
Methylene Chloride	75-09-2	1.0	0.23
Methyl ethyl ketone (2-Butanone)	78-93-3	20	1.38
Iodomethane	74-88-4	1.0	0.30
4-Methyl-2-pentanone	108-10-1	10	1.73
Styrene	100-42-5	1.0	0.18
1,1,2-Tetrachloroethane	79-00-5	1.0	0.18
1,1,2,2-Tetrachloroethane	79-34-5	1.0	0.14
Tetrachloroethene[1]	127-18-4	1.0	0.16
Toluene	108-88-3	1.0	0.16
1,1,1-Trichloroethane	71-55-6	1.0	0.18
1,1,2-trichloroethane	79-00-5	1.0	0.14
Trichloroethene[1]	79-01-6	1.0	0.15
Trichlorofluoromethane	75-69-4	1.0	0.08
1,2,3-Trichloropropane	96-18-4	1.0	0.16
Vinyl acetate	108-05-4	1.0	1.01
Vinyl chloride	75-01-4	1.0	0.13
Xylenes	108-38-3 106-42-3 95-47-6	1.0	0.34

* Also MSWP Table 2 analyte
PQL = Practical Quantitation Limit
MDL = Method Detection Limit
[1] ...ethene = ...ethylene

Table 6
MSWP Table 2 Methods, PQLs and MDLs
Inorganic Constituents

Analyte	EPA Method	PQL (mg/L or as shown)	MDL (mg/L or as shown)
Antimony*	204.2	0.05	0.003
Arsenic*	206.2	0.005	0.0007
Barium*	200.7	0.1	0.001
Beryllium*	200.7	0.001	0.0003
Cadmium*	200.7	0.001	0.00094
Chromium*	200.7	0.01	0.004
Cobalt*	200.7	0.01	0.002
Copper*	200.7	0.01	0.003
Iron*	200.7	0.03	0.002
Lead*	239.2	0.002	0.001
Mercury*	245.2	0.001	0.0001
Nickel*	200.7	0.01	0.009
Selenium*	270.3	0.005	0.0006
Silver*	200.7	0.005	0.004
Thallium*	279.2	0.1	0.001
Tin	2.007	0.1	0.016
Vanadium*	200.7	0.10	0.009
Zinc*	200.7	0.01	0.001
Cyanide*	335.3	0.005	0.0015
Sulfide	376.2	0.04	0.008

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
* = also MSWP Table 1 analyte

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Organochlorine Pesticides by Method 8080

Analyte	Chemical Abstract Service Registry No.	PQL (µg/L or as shown)	MDL^3 (µg/L or as shown)
Aldrin	309-00-2	0.05	0.00058
alpha-BHC	319-84-6	0.05	0.00071
beta-BHC	319-85-7	0.05	0.0011
delta-BHC	319-86-8	0.05	0.0016
gamma-BHC; Lindane	58-89-9	0.05	0.00063
Chlordane; alpha-	5103-71-9	0.05	NA
beta-	5103-74-2	0.05	NA
gamma-	5566-34-7	0.05	NA
constituents	57-74-9	0.1	NA
	12789-03-6	NA	NA
4,4'-DDD	72-54-8	0.1	0.0018
4,4'-DDE	72-55-9	0.1	0.00098
4,4'-DDT	50-29-3	0.1	0.0024
Dieldrin	60-57-1	0.1	0.0010
Endosulfan I	959-98-8	0.05	0.0019
Endosulfan II	33213-65-9	0.10	0.0013
Endosulfan Sulfate	1031-07-8	0.10	NA
Endrin	72-20-8	0.10	0.0016
Endrin Aldehyde	7421-93-4	0.10	0.0023
Heptachlor	76-44-8	0.05	0.0014
Heptachlor Epoxide	1024-57-3	0.05	0.0014
Methoxychlor	72-43-5	0.50	0.0027
Toxaphene (Chlorinated Camphene)	8001-35-2	5.0	0.16

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
[3] MDLs calculated based on Instrument Detection Limits (IDLs)
NA = Not Available currently, expected to be available 3/94

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Polychlorinated Biphenyls (PCBs) by Method 8080

Analyte	Chemical Abstract Service Registry No.	PQL (μg/L or as shown)	MDL[3] (μg/L or as shown)
PCBs	1336-36-3	50	NA
Aroclor-1016	12674-11-2	1.0	NA
Aroclor-1221	11104-28-2	2.0	NA
Aroclor-1232	11141-16-5	1.0	NA
Aroclor-1242	53469-21-9	1.0	NA
Aroclor-1248	12672-29-6	1.0	NA
Aroclor-1254	11097-69-1	1.0	NA
Aroclor-1260	11096-82-5	1.0	NA

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
NA = Not Available currently, expected to be available 3/94

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Chlorinated Herbicides by Method 8150

Analyte	Chemical Abstract Service Registry No.	PQL (μg/L or as shown)	MDL[3] (μg/L or as shown)
2,4-D	94-75-7	1.0	0.017
Dinoseb	88-85-7	1.0	0.012
Silvex	93-72-1	0.1	0.0046
2,4,5-T	93-76 -5	0.1	0.0025

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Volatile Organics (Long List) by Method 8260

Analyte	Chemical Abstract Service Registry No.	PQL (µg/L or as shown)	MDL (µg/L or as shown)
Acetone*	67-64-1	20	1.70
Acetonitrile	75-05-8	100	0.91[3]
Acrolein	107-02-8	20	NA
Acrylonitrile*	107-13-1	20	1.77
Allyl chloride	107-05-1	10	NA
Benzene*	71-43-2	1.0	0.07
Bromochloromethane*	74-97-5	1.0	0.09
Bromodichloromethane*	75-27-4	1.0	0.08
Bromoform*	75-25-2	1.0	0.06
Bromomethane*	74-83-9	1.0	0.21
Carbon Disulfide*	75-15-0	1.0	0.08
Carbon Tetrachloride*	56-23-5	1.0	0.18
Chlorobenzene*	108-90-7	1.0	0.18
Chloroethane*	75-00-3	1.0	0.45
Chloroform*	67-66-3	1.0	0.11
Chloroprene	126-99-8	20	NA
Chlorodibromomethane*	124-48-1	1.0	0.11
Chloromethane*	74-87-3	1.0	0.37
Dibromomethane*	74-95-3	1.0	0.11
1,2-Dibromo-3-chloropropane (DBCP)*	96-12-8	1.0	0.17
1,2-Dibromoethane(EDB)*	106-93-4	1.0	0.08
1,2-Dichlorobenzene*	95-50-1	1.0	0.06
1,3-Dichlorobenzene	541-73-1	1.0	0.09

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
NA = Not Available currently, expected to be available 3/94
* = also MSWP Table 1 analyte

[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Volatile Organics (Long List) by Method 8260, Continued

Analyte	Chemical Abstracts Service Registry No.	PQL (µg/L or as shown)	MDL (µg/L or as shown)
1,4-Dichlorobenzene*	106-46-7	1.0	0.14
trans-1,4-Dichloro-2-butene*	110-57-6	1.0	NA
Dichlorodifluoromethane[2]	75-71-8	1.0	0.11
1,1 Dichloroethane*	75-34-3	1.0	0.14
1,2-Dichloroethane*	107-06-2	1.0	0.05
1,1-Dichloroethene[1]*	75-35-4	1.0	0.24
cis-1,2-Dichloroethene[1]*	156-59-2	1.0	0.14
trans-1,2-Dichloroethene[1]*	156-60-5	1.0	0.14
1,2 Dichloropropane*	78-87-5	1.0	0.11
1,3 Dichloropropane	142-28-9	1.0	0.03
2,2 Dichloropropane	594-20-7	1.0	0.09
1,1 Dichloropropene	563-58-6	1.0	0.08
cis-1,3-Dichloropropene*	10061-01-5	1.0	0.07
trans-1,3-Dichloropropene*	10061-02-6	1.0	0.06
Ethylbenzene*	100-41-4	1.0	0.13
Ethyl methacrylate	97-63-26	5	0.16[3]
Hexachlorobutadiene	87-68-3	1.0	0.15
2-Hexanone*	591-78-6	10	1.62
Isobutyl alcohol	78-83-1	50	NA
Methacrylonitrile	126-98-7	10	0.94[3]
Methylene Chloride* (Dichloromethane)	75-09-2	1.0	0.23

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
* = also MSWP Table 1 analyte
[1] ...ethene = ...ethylene
[2] specific to Laurel Landfill
[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Volatile Organics (Long List) by Method 8260, Continued

Analyte	EPA Method	PQL (µg/L or as shown)	MDL (µg/L or as shown)
Methyl ethyl ketone (2-Butanone)*	78-93-3	20	1.38
Methyl methacrylate	80-62-6	2	0.21[3]
Iodomethane*	74-88-4	1.0	0.30
4-Methyl-2-pentanone*	108-10-1	20	1.73
Naphthalene	91-20-3	1	0.12
Propionitrile	107-12-0	60	1.87[3]
Styrene*	100-42-5	1.0	0.18
1,1,1,2-Tetrachloroethane*	630-20-6	1.0	0.18
1,1,2,2-Tetrachloroethane*	79-34-5	1.0	0.14
Tetrachloroethene[1]*	127-18-4	1.0	0.16
Toluene*	108-88-3	1.0	0.16
1,2,4-Trichlorobenzene	120-82-1	1	0.13
1,1,1-Trichloroethane*	71-55-6	1.0	0.18
1,1,2-trichloroethane*	79-00-5	1.0	0.14
Trichloroethene[1]*	79-01-6	1.0	0.15
Trichlorofluoromethane*	75-69-4	1.0	0.08
1,2,3-Trichloropropane*	96-18-4	1.0	0.16
Vinyl acetate*	108-05-4	10	1.01
Vinyl chloride*	75-01-4	1.0	0.13
Xylenes*	108-38-3 106-42-3 95-47-6	1.0	0.34

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
* = also MSWP Table 1 analyte
[1] ...ethene = ...ethylene
[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Semi-Volatile Organics by Method 8270

Analyte	Chemical Abstract Service Registry No.	PQL (µg/L or as shown)	MDL[3] (µg/L or as shown)
Acenaphthene	83-32-9	10	0.6
Acenaphthylene	208-96-8	10	0.8
Acetophenone	98-86-2	10	NA
2-Acetylaminofluorene	53-96-3	20	NA
4-Aminobiphenyl	92-67-1	20	NA
Anthracene	120-12-7	10	0.7
Benzo[a]anthracene	56-55-3	10	0.9
Benzo[b]fluoranthene	205-99-2	10	2.0
Benzo[k]fluoranthene	207-08-9	10	1.0
Benzo[ghi]perylene	191-24-2	10	1.1
Benzo[a][pyrene	50-32-8	10	0.8
Benzyl alcohol	100-51-6	20	NA
Bis(2-chloroethoxy)-methane	111-91-1	10	1.0
Bis(2-chloroethyl) ether	111-44-4	10	0.80
Bis(2-chloro-1-methylethyl) ether	108-60-1	10	0.80
Bis(2-ethylhexyl)-phthalate	117-81-7	10	1.9
4-Bromophenyl phenyl ether	101-55-3	10	0.7
Butyl benzyl phthalate	85-68-7	10	1.8
p-Chloroaniline	106-47-8	20	NA
Chlorobenzilate	510-15-6	10	NA
p-Chloro-m-cresol	59-50-7	10	1.0
2-Chloronaphthalene	91-58-7	10	0.9
2-Chlorophenol	95-57-8	10	0.7

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
NA = Not Available currently, expected to be available 3/94
[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Semi-Volatile Organics by Method 8270, Continued

Analyte	Chemical Abstract Service Registry No.	PQL (µg/L or as shown)	MDL[3] (µg/L or as shown)
4-Chlorophenyl phenyl ether	7005-72-3	10	0.7
Crysene	218-01-9	10	1.8
3-methylphenol	108-39-4	10	0.7
2-methylphenol	95-48-7	10	0.8
4-methylphenol	106-44-5	10	0.7
Diallate	2303-16-4	10	NA
Dibenzo[a,h]anthracene	53-70-3	10	1.3
Dibenzofuran	132-64-9	10	NA
Di-n-butyl phthalate	84-74-2	10	1.2
3,3'-Dichlorobenzidine	91-94-1	20	2.0
2,4-Dichlorophenol	120-83-2	10	1.0
2,6-Dichlorophenol	87-65-0	10	NA
Diethyl phthalate	84-66-2	10	0.7
o,o-Diethyl o-2-pyrazinyl	297-97-2	20	NA
Dimethoate	60-51-5	20	NA
p-(Dimethylamino)-azobenzene	60-11-7	10	NA
7,12-Dimethylbenz[a]-anthracine	57-97-6	10	NA
3,3'-Dimethylbenzidine	119-93-7	10	NA
2,4-Dimethylphenol	105-67-9	10	0.8
Dimethyl phthalate	131-11-3	10	0.7
m-Dinitrobenzene	99-65-0	20	NA
4,6-Dinitro-o-cresol	534-52-1	50	2.1
2,4-Dinitrophenol	51-28-5	50	7.4
2,4-Dinitrotoluene	121-14-2	10	NA

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
NA = Not Available currently, expected to be available 3/94

[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Semi-Volatile Organics by Method 8270, Continued

Analyte	Chemical Abstract Service Registry No.	PQL (µg/L or as shown)	MDL[3] (µg/L or as shown)
2,6-Dinitrotoluene	606-20-2	10	1.0
Di-n-octyl phthalate	117-84-0	0	1.9
Diphenylamine	122-39-4	10	NA
Disulfoton	298-04-4	10	NA
Ethyl methanesulfonate	62-50-0	10	NA
Famphur	52-85-7	20	NA
Fluoranthene	206-44-0	10	0.8
Fluorene	86-73-7	10	0.5
Hexachlorobenzene	118-74-1	10	1.3
Hexachlorocyclopentadiene	77-47-4	10	0.8
Hexachloroethane	67-72-1	10	0.8
Hexachloropropene	1888-71-7	10	NA
Indeno(1,2,3-cd)pyrene	193-39-5	10	1.1
Isodrin	465-73-6	20	NA
Isophorone	78-59-1	10	1.4
Isosafrole	120-58-1	10	NA
Kepone	143-50-0	20	NA
Methapyrilene	91-80-5	100	NA
3-Methylcholanthrene	56-49-5	10	NA
Methyl methanesulfonate	66-27-3	10	NA
2-Methylnaphthalene	91-57-6	10	0.9
Methyl parathion	298-00-0	10	NA
1,4-Naphthoquinone	130-15-4	10	NA
1-Naphthylamine	134-32-7	10	NA
2-Naphthylamine	91-59-8	10	NA

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
NA = Not Available currently, expected to be available 3/94

[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Semi-Volatile Organics by Method 8270, Continued

Analyte	Chemical Abstract Service Registry No.	PQL (µg/L or as shown)	MDL[3] (µg/L or as shown)
2-Nitroaniline	88-74-4	50	NA
3-Nitroaniline	99-09-2	50	NA
4-Nitroaniline	100-01-6	20	NA
Nitrobenzene	98-95-3	10	1.1
2-Nitrophenol	88-75-5	10	1.1
4-Nitrophenol	100-02-7	50	2.5
N-Nitrosodi-n-butylamine	924-16-3	10	NA
N-Nitrosodiethylamine	55-18-5	20	NA
N-Nitrosodimethylamine	62-75-9	10	1.4
N-Nitrosodiphenylamine	86-30-6	10	1.3
N-Nitroso-Di-n-propylamine	621-64-7	10	0.8
N-Nitroso methylethylamine	10595-95-6	10	NA
N-Nitrosopiperidine	100-75-4	20	NA
N-Nitrosopyrrolidine	930-55-2	40	NA
5-Nitro-o-toluidine	99-55-8	10	NA
Parathion	56-38-2	10	NA
Pentachlorobenzene	608-93-5	10	NA
Pentachloronitrobenzene	82-68-810	20	NA
Pentachlorophenol	87-86-5	50	1.5
Phenacetin	62-44-2	20	NA
Phenanthrene	85-01-8	10	0.8
Phenol	108-95-2	10	1.0
p-Phenylenediamine	106-50-3	10	NA

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
NA = Not Available currently, expected to be available 3/94
[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 6 Continued
MSWP Table 2 PQLs and MDLs
Semi-Volatile Organics by Method 8270, Continued

Analyte	Chemical Abstract Service Registry No.	PQL (µg/L or as shown)	MDL[3] (µg/L or as shown)
Phorate	298-02-2	10	NA
Promanide	23950-58-5	10	NA
Pyrene	129-00-0	10	2.4
Safrole	94-59-7	10	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	10	NA
2,3,4,6-Tetrachlorophenol	58-90-2	10	NA
0-Toluidine	95-53-4	10	NA
2,4,5-Trichlorophenol	95-95-4	10	0.8
2,4,6-Trichlorophenol	88-06-2	10	0.8
0,0,0-Triethyl phosphorothioate	126-68-1	10	NA
sym-Trinitrobenzene	99-35-4	10	NA

PQL = Practical Quantitation Limit
MDL = Method Detection Limit
NA = Not Available currently, expected to be available 3/94
[3] MDLs calculated based on Instrument Detection Limits (IDLs)

Table 7
Description of Laboratory Generated QA/QC Samples

QA/QC Sample	Description of Sample	Analytes
Replicate or Duplicate	an aliquot of the original sample is treated as a separate sample; a measure of method precision	All analytes for the method
Fortified or Spiked Sample	known constituents in known amounts are added to an aliquot of the original sample; percent recovery is calculated; a measure of method sensitivity and accuracy	All analytes for the method Spike recovery is reported
Matrix Spike	known constituents in known amounts are added to an aliquot of laboratory water; percent recovery is calculated; a measure of method sensitivity and accuracy	All analytes for the method Spike recovery is reported
Method Blank and Trip Blanks	an aliquot of laboratory water; a measure of method accuracy	All analytes for the method
Water Volatile Surrogate Recovery	known constituents in known concentrations are added to original samples; percent recovery is calculated; a measure of method sensitivity and accuracy	All analytes for the method Toluene, Bromofluorobenzene, and 1,2-Dichloroethane recoveries reported
EPA Control Sample	an aliquot of water supplied by EPA for certification purposes, constituents and concentrations are known by EPA, a measure of method sensitivity and accuracy	All analytes for the method
EPA Reference Sample	an aliquot of water supplied by EPA, constituents and concentrations are known the laboratory, a measure of method sensitivity and accuracy	Known analytes
Matrix Spike/Matrix Spike Duplicate	Duplicate samples of laboratory water, spiked with the same concentrations; percent recovery and relative percent difference are calculated; a measure of method precision sensitivity and accuracy	All analytes for the method Spike recovery is reported

Table 8
Laboratory Generated QA/QC Sample Analytes by EPA Method Number

EPA Method	QA/QC Samples	Analytes
8080	Distilled water method blank Laboratory duplicate Spike samples	All analytes for the method All analytes for the method All analytes for the method
8150	Distilled water method blank Laboratory duplicate Spike samples	All analytes for the method All analytes for the method All analytes for the method
8260	Four sample replicates Four spiked sample replicates Surrogate Method Blank Standard reference samples	All analytes for the method All analytes for the method All analytes for the method All analytes for the method All analytes for the method
8270	Four sample replicates Four spiked sample replicates Surrogate Method Blank Standard reference samples	All analytes for the method All analytes for the method All analytes for the method All analytes for the method All analytes for the method
Anions, metals,COD, pH, Sc, and Cyanide	Method blank Duplicate Spiked sample Check standard Standard reference sample	All analytes for the method All analytes for the method All analytes for the method All analytes for the method All analytes for the method

Table 9
Sampling Equipment Checklist

Project No. 112035
Location: Laurel Landfill License #203
Project Name: Laurel Landfill
Date: ______

___ Make Ice
___ Determine order of sampling

___ Field Log Book
___ Completion logs for wells of concern
___ Well key
___ Gate access key
___ Calculator
___ Waterproof field book
___ Waterproof pen
___ Magic marker
___ Watch
___ Chain of custody form(s)
___ Clear tape

___ Submersible pump
___ Pump control box
    ___ Electric generator
    ___ Electrical cord 25-50 feet
    ___ 100 ft Poly rope w/link

___ Stainless steel bailer
___ PVC sample bailer w/link
___ 2" Purge bailer w/link
___ Rope
___ 5-gallon buckets (3)
___ Chain with "S" hook

___ 10% Nitric acid
___ Methanol
___ Liquinox
___ De-Ionized water (2 gallons) **for metals**

___ Potable water (10 gallons) for pre-rinse
___ Distilled water (5-gallons) **for VOCs**
___ Brushes, long handle and short handle
___ Paper towels
___ Spray bottles (3)
___ Disposable gloves
___ Heavy plastic gloves
___ 6-mil poly sheeting
___ Aluminum foil

___ pH meter with extra batteries (9-volt)
    ___ 4, 7, 10 buffers

___ Specific conductance meter with extra batteries (2 D cells)
    ___ 147, 1413, 12,900 standards

___ Water level meter with extra battery (9-volt)
___ 1-liter wide mouth glass bottles (3)

___ Cooler with ice
___ Filtration unit
___ Filters
    ___ Tygon tubing

___ 1-liter wide mouth glass bottle
___ Sample bottles
___ Duplicate sample bottles
___ Equipment blank bottles

___ Preservatives (samples plus QA/QC)

___ Sample labels

___ Hard hat(s)
___ Safety glasses
___ Long sleeve shirt
___ Steel toe boots
___ Coveralls (Tyvek)
___ Leather gloves
___ Sun screen
___ Drinking water
___ Paper cups
___ Flashlight w/ batteries (2 D cells)
___ First Aid kit

___ Tool box
    ___ Steel tape
    ___ Hammer
    ___ Pliers
    ___ Knife
    ___ Crescent wrench
    ___ Vise grips
    ___ Duct tape

5.0 QUALITY ASSURANCE/QUALITY CONTROL PLAN

Activities required to produce accurate, precise, and repeatable results are an integral part of field sampling activities and laboratory analytical procedures. This QA/QC Plan presents procedures as required by ARM 16.14.706(1)(b) and (c).

5.1 Field Quality Assurance/Quality Control Plan

A QA/QC Plan depends on meticulous attention to detail and documentation by field personnel. Field sampling personnel are responsible for following standard operating procedures for equipment calibration and decontamination, well monitoring, sample collection including QA/QC samples, preservation, labeling, storage and transportation to the analytical laboratory. All activities must be documented with care to verify correct handling and permit accurate reporting of results.

5.1.1 Field Sampling Standard Operating Procedures

Standard operating procedures include:

- Equipment maintenance;
- Equipment decontamination;
- Equipment calibration;
- Sample collection and preservation;
- Sample storage and handling;
- Field documentation of sampling activities.

5.1.1.1 Equipment Maintenance

- The Orion Model 230A pH meter should be wiped clean with a damp cloth after each field use. The probe should be stored in the slip cover provided with the instrument. A small amount of cotton should be place in the slip cover and kept wet with pH electrode storage solution (Orion #910001). The level of probe filling solution should be maintained at a height above the junction in the probe. When the probe is not in use, it should be disconnected from the meter. The band cover should be placed over the fill hole to prevent solution leakage, and the slip cover with damp cotton should be placed over the probe tip. The 9 volt battery should be removed from the meter when it is not in use. A new battery will be used when "bat" is displayed in the lower right corner of the LCD display screen. Electronic and hardware diagnostic tests are conducted each time the meter is calibrated. If errors are reported during the diagnostic tests or the calibration procedures, the instrument manual will be consulted.

- The YSI Model 33 S-C-T meter should be wiped clean with a damp cloth after each use and the probe should be stored in deionized water. The existing deionized water should be replaced at the start of each sampling event with clean, unused deionized water. The two D cell batteries should be replaced when the red line adjustment cannot be accomplished. Any recalibration must be performed at the factory.
- The Well Wizard Water Level Meter Model 6000 should be wiped clean with potable water and a damp paper towel after each field use. The 9-volt battery should be replaced when the auditory or visual signal becomes weak or fails.

5.1.1.2 Equipment Decontamination

All equipment which comes in contact with the groundwater will be decontaminated immediately prior to use. Variations in decontamination procedures are appropriate for various pieces of equipment. Decontamination is recorded as part of Well Purging and Sampling Information, Form 112311S.

Equipment: Water level meter and graduated cable
Stainless steel sampling bailer

Procedure:

- Triple wash with phosphate-free detergent solution (Liquinox) and a brush;
- Triple rinse with potable water;
- Triple rinse with distilled water; and
- Air dry.

Equipment: PVC sampling bailer
Glass field filtration funnel and flask

Procedure:

- Triple wash with phosphate-free detergent solution (Liquinox) and a brush;
- Triple rinse with potable water;
- Assemble filtration apparatus;
- Triple rinse with 10 ml or more of 10 percent nitric acid (1 part nitric acid in 9 parts de-ionized water);

Procedure for Filtration apparatus:

  - Place 10 ml of 10 percent nitric acid into the funnel;
  - Apply 5 to 10 psig vacuum to the catch flask using the hand vacuum pump;
  - Rinse the flask and discard the acid solution after it has passed into the flask;
  - Repeat acid rinse twice more;
  - Triple rinse with de-ionized water as for acid rinse; and,
- Air Dry.

Equipment: Field temperature sensor
pH probe
Specific conductance probe

Procedure:

- Do not apply detergent or brush scrubbing to these sensitive instruments;
- Triple rinse with deionized water from a squeeze bottle;
- Forcefully direct the stream of water around the bulb of the pH probe and into the channels in the conductivity probe;
- Store the conductivity probe in deionized water and the pH probe in wetting solution provided with the meter when not in use.

A fourth procedure will be used if petroleum hydrocarbon contamination becomes evident in the monitoring wells at the Laurel Landfill. A methanol rinse is added after the liquinox wash and potable water rinse to remove the petroleum hydrocarbons and followed with a final triple rinse with the rinsate specified for the equipment. The decision to include the methanol rinse is made in the field.

5.1.2 Field Documentation Procedures

Two types of log books will be maintained. A Site Log Book will be bound with individual pages being sewn or glued together. Sufficient details including but not limited to those listed below will be included to reconstruct the events without relying on memory. The records will be completed in waterproof ink and will be legible and complete. Each Field Log Book will be a compendium of forms pertinent to the specific field activity. More than one Field Log Book may be in use at one time. Information will be provided in only one of the log books to prevent duplication of information except for that required to cross reference information.

The first page in the Site Log Book will contain:

- Name and address of City of Laurel contact;
- Description of Landfill location.

For each site visit or event, the following information will be provided:

- date(s);
- names of persons on site and their responsibilities;
- visitors on site and their telephone numbers;
- field activities conducted and their purposes;
- start time of each field activity;
- description of variances to approved Post Closure Plan;
- well ID numbers cross referenced with laboratory sample identification numbers;

- mode of sample transportation;
- references to other forms contained in Field Log Books by title and form number for the specific events; and,
- signature and initials of person providing the information.

A Field Log Book will be specific to each field event and will be a compendium of forms pertinent to that specific field activity or time period. These log books will be bound with plastic or stapled together. The Field Log Book for groundwater sampling events will include:

- a map of well locations at Laurel Landfill, Figure 3;
- a list of sampling activities, in chronological order, Form 112312S;
- Sampling Equipment Checklist, Form 112310S;
- 5 copies of Monitoring Well Inspection, Report Form 112002I;
- 8 copies of Well Purging and Sampling Information, Form 112311S;
- two Calibration Logs for each instrument used, Forms 112206C - 112209C;
- a list of container, volume collected, and preservative for each sample aliquot, Form 112313S;
- several Variance Records, Form 112105F;
- a chain-of-custody record; and,
- several Field Observations, Form 112104F.

These forms are found in Appendix C.

5.1.3 Frequency of QA/QC Sample Collection

Replicate and blank samples are collected to demonstrate repeatability of procedures and adequacy of decontamination procedures. The types of QA/QC samples to be collected include a trip blank, a field blank, an equipment rinse blank, and a duplicate as presented in Section 4.4.5. The frequency of collection is:

- one trip blank per sampling event;
- one field blank per 10 gallons of distilled water purchased or once per event;
- one equipment rinse blank per sampling event; and,
- one duplicate natural sample per ten natural samples with a minimum of one duplicate per sampling event.

The trip blank will be analyzed only if no other sample in the set shows non-detectible levels of all volatile organic analytes.

5.1.4 Field Equipment Calibration

Calibration procedures and frequencies are specific to each instrument. At a minimum, each instrument will be calibrated before and at the conclusion of each day

of sampling. Any drift in calibration will be assumed to be linear with time between the pre- and post calibrations. Data will be corrected for calibration drift. Reported data will be corrected per the calibrations and/or to standard conditions.

Equipment: Well Wizard model 6000 water level meter:
Form Number: 112006C

- Record manufacturer, model and serial numbers of the instrument;
- Power the instrument;
- Push the test button to check operability of audible signal;
- As the probe is held vertically or horizontally, approximately 10 to 20 feet from the cable reel, use a steel tape graduated in 0.01 foot increments to measure the distance from:
  1) tip of probe to the sensor level;
  2) sensor to the 1-foot mark on the graduated portion of cable;
  3) sensor to the 10 and/or 20 foot mark on the cable;
- Record steel tape measurement on the Well Probe Calibration Form found in Appendix C; and,
- Calculate calibration correction factors.

Equipment: YSI model 33 Specific Conductivity Meter:
Form Number: 112008C
Note: Replace Standard solutions on an annual basis;
Note: The probe is stored in deionized water when not in use;

- Record, manufacturer, model and serial numbers of the instrument;
- Adjust the meter zero, if necessary, by adjusting bakelite screw on face of meter so that meter needle coincides with zero on the conductivity scale;
- Turn mode control to REDLINE and if necessary adjust REDLINE CONTROL so meter needle coincides with red line;
- If REDLINE adjustment cannot be accomplished, replace batteries;
- Place conductivity probe into probe jack on face of meter;
- Place probe into 12,900 µmho/cm standard solution;
- Turn mode control to temperature and allow reading to stabilize;
- Gently raise and lower the probe to speed stabilization;
- Record temperature in degree Celsius as read on lower (-2 to 50) scale;
- Switch scale to X100;
- Read and record the conductivity read on the upper (0 to 500) scale;
- Depress the CELL TEST button;
- Read and record conductivity;
- Calculate drop in conductivity;
- If the conductivity drops more than 2 percent, the reading is in error and the probe must be cleaned (by soaking in bathroom tile cleaning preparation for five minutes then rinse well with potable water and then with deionized water);
- Calculate a cell constant as shown on Table 10 on page 60; and,

- Record calibration data on the Specific Conductance Meter Calibration Form found in Appendix C.
- If a scale other than X100 is needed, repeat the above procedures for the pertinent scale.

Equipment: Field Temperature Sensors:
Form Number: 112007C

Note: Two calibration standards comprised of tap water are kept at different temperatures, approximately zero and 25 degrees celsius;

- pH and specific conductivity meter temperature sensors and standard thermometer are placed into cold standard and allowed to stabilize;
- Temperatures are recorded on the calibration form;
- Temperature sensors and standard thermometer are placed into room temperature standard and allowed to stabilize;
- Temperatures are recorded on the calibration form; and,
- Prepare linear calibration curve.

Equipment: Orion model 310 pH meter:
Form Number: 112009C

Note: Replace buffer solutions on an annual basis;
Note: The electrode tip is stored wet (a cotton ball moistened with storage solution is kept in the tip of the storage cover);

- Record, manufacturer, model and serial numbers of the instrument;
- Electronic and hardware diagnostic tests should be conducted by attaching the BNC shorting strap to the BNC connector on top of the meter;
- Depress the POWER key turn on the meter;
- If the low battery indicator is displayed, replace the battery;
- Turn the meter off by depressing the POWER key;
- Begin the diagnostic tests by depressing and holding the YES key while pressing the POWER key;
- After code 7, a "0" will appear on the display which is the signal to press each key in turn within a total of 10 seconds;
- After the diagnostic tests are completed successfully, turn off the meter and remove the shorting strap;
- Connect pH and automatic temperature compensation (ATC) probe to meter;
- Remove plastic cover from hole on probe, sliding cover to just below the hole;
- Check that the probe is filled to a level above the junction;
- If necessary, add filling solution to the probe;
- Power the instrument and enter setup menu;
- Record setup parameter settings;

- Place probe in pH 7 buffer solution;
- Push "CAL": CALIBRATE and P1 will be displayed;
- After the instrument stabilizes and flashes "ready", record actual pH;
- Press "YES";
- The display will remain frozen for two seconds then P2 will be displayed;
- Rinse electrode and place in pH 10 buffer;
- After the instrument stabilizes and flashes "ready", record actual pH;
- Press "YES";
- Record the electrode slope which is displayed as a percentage in the main field;
- Rinse the electrode with deionized water;
- The meter will enter the measure mode;
- Perform a calibration with pH 7 buffer every two hours to compensate for electrode drift;
- Record calibration data on the pH Calibration Form found in Appendix C; and,
- No calibration factor is calculated, the meter provides calibrated readout.

5.1.5 Chain-of-Custody Procedures

A chain-of-custody record supplied by Energy Laboratories will be completed for all samples as they are collected. The record will include:

- the project name and number;
- name of the analytical laboratory destination;
- sampler's signature;
- sample identification number, date and time of collection, composite or grab sample;
- number of containers and type of sample;
- analysis requested and number of containers provided per analysis;
- any special instructions or hazard warnings.

Upon relinquishing custody of the samples, both parties to the exchange will sign and date the record noting military time of the exchange of custody. The sampler will be the first relinquishing signature and the laboratory personnel will be the final receiving signature. Intermediate signatures may or may not be present.

Sampling personnel will retain custody of the samples or assure their integrity through the use of custody seals between the time of collection and delivery to the analytical laboratory. An example chain-of-custody form is shown in Appendix C. A chain-of-custody form will be obtained from Energy Laboratories for each sampling event.

If sample custody seals are used, the following information will be provided on the seals:

- Date;
- Sample identification number;
- Sampler's signature.

The seals will be attached to each sample container and/or to the cooler which contains the sample containers in such a way that it is necessary to break the seal in order to access the sample(s). Custody seals are affixed before the sample leaves the custody of the sampling personnel.

5.2 Laboratory Quality Assurance/Quality Control Plan

5.2.1 Laboratory Identification

The analytical laboratory which will analyze the groundwater samples collected at the Laurel Landfill is the headquarters facility of Energy Laboratories, Inc. The facility is located at 1107 South Broadway in Billings. The mailing address is P.O. Box 30916, Billings, Montana, 59107.

Energy Laboratories is equipped to follow the analytical methods reference in EPA's "Methods for Chemical Analysis of Water and Wastes, "EPA-600, and "Test Methods for Evaluating Solid Waste, Physical /Chemical Methods, "SW-846, third edition, September 1986 as required at ARM 16.14.706(9).

5.2.2 Sample Custody

When accepting custody of the samples, laboratory personnel will compare information on the sample bottles with that on the chain of custody. If something has been omitted, the sample collector is notified and the missing information is requested. Samples that are preserved by the sample collector are checked for proper pH to ensure that enough preservative was added. If samples are improperly preserved or the maximum holding time has been exceeded, the sampler is notified and resampling is requested. All samples are recorded in the laboratory log and given a unique laboratory sample-tracking number.

5.2.3 Analytical Turn-Around Time

Analytical turnaround time is dependent on the number of samples awaiting analysis and/or by arrangement with the sampler. All samples are analyzed within the holding period time for the specific method. Method 8260 Volatile Organic Compound analysis is performed within 14 days of sampling. Method 8080, 8150, and 8270 samples are extracted within 7 days and analysis is accomplished within 40 days. The

holding time for individual samples is shown in Table 5 and 6 on pages 31 and 34. An average turn-around time for the full suite of MSWP Table 1 analytes is approximately four weeks.

5.2.4 Calibration Procedures and Frequency

Calibration procedures at Energy Laboratories follow instrument and equipment manufacturer's instructions and EPA, ASTM, or other published method procedures. Initial instrument calibration curves are generated, verified, and routinely monitored by continuing calibration checks throughout the duration of all instrumental analysis. Whenever possible, Energy Laboratories uses EPA traceable calibration standards. Standards preparation notebooks document the source, purity, content, concentration, date and analyst.

Samples are only quantitated within the limits of the response of the calibration standards. Volumetric dilution of high concentration samples is used to bring sample analyte concentrations within the calibration range. Calibrations may occur more frequently as indicated by instrument maintenance activities or out-of-control conditions. The type of calibrations and frequencies required by the EPA methods are presented in Table 11 on page 61.

5.2.5 Data Reduction, Validation, and Reporting

Data reduction refers to the process of converting raw data to reportable units. Wherever possible, the analytical instrument is calibrated to read out directly in the reporting units and the values are recorded directly into a laboratory notebook or logbook and onto the raw data forms for review. In cases where calculation is required prior to reporting, raw data is recorded in the appropriate laboratory notebook and on the appropriate laboratory form. In this case, the calculations specified in the method are used to determine the reported value which is also entered in the laboratory notebook and on the draft of the client report. Most of the calculations are computerized to reduce the potential for arithmetic or transcription errors.

Data validation includes the procedures to insure that the reported values are consistent with the raw data and calculated values. The data recorded on the draft laboratory report is validated with four steps: 1) the analyst who submits the report checks all the values reported for omissions and accuracy; 2) the report is reviewed and necessary data reduction is performed by the supervisor; 3) the reports are typed, proof read, and reviewed by the word processing staff, and 4) the report is reviewed by the manager or his designee who examines the validity of the data and signs the final report.

One copy of the report is mailed to the client on the day the data is reported and one copy is filed in the separate client file maintained at Energy Laboratories.

5.2.6 Internal Quality Control Checks

The Quality Control Program at Energy Laboratories includes a demonstration of laboratory capability, a demonstration of the analyst's ability, the analysis of quality control samples, and the maintenance of performance records.

Laboratory glassware conforms to National Bureau of Standards (NBS) Class A standards. All mechanical pipettes are calibrated monthly. Thermometers are annually calibrated against an NBS certified thermometer and routinely checked for accuracy. Laboratory pure water is generated by commercial water purification systems and is monitored daily and documented according to resistivity meter readings. Laboratory pure water meets ASTM Type II criteria. Chemical reagents and gases exceed purity requirements for their intended uses. Laboratory stock and working standards are derived from commercially available primary standards and solvents whenever possible.

Analytical Equipment Standard Operating Procedures (AESOPs) have been developed for each major piece of equipment and instrumentation. The AESOPs detail the sequence of operations involved in instrument start-up, calibration, analyzing, and shutdown. AESOPs also included recommended schedules for routine preventive maintenance and identify those parameters which dictate other types of maintenance. Acceptable instrument response/performance criteria are based upon the manufacturer's or the analytical method specifications.

Analytical Method Standard Operating Procedures (AMSOPs) have been developed by Energy Laboratories for well detailed EPA, ASTM, and published procedures. Qualified personnel capable of performing each method are on staff at Energy Laboratories. It is the responsibility of each analyst to become thoroughly familiar with methodology and instrument operation before performing the analysis. The performance of each analyst is monitored during the training period by a supervisor until the analyst demonstrated the ability to generate results of acceptable accuracy and precision as required by each method.

Quality control monitoring requires that ten percent of all samples analyzed be fortified (spiked) with a known concentration of the analytes stipulated by the method. Percent recovery is calculated as a means of monitoring method accuracy. Where appropriate, the use of surrogates are included in the method to monitor method performance on each sample. The method may also require duplicate samples to be prepared and analyzed when possible. When duplicate samples are analyzed, relative percent difference is calculated and used to monitor precision of the method. In the instances where there are no specific method requirements, it is the policy of Energy Laboratories to analyze ten percent of all samples in duplicate. Matrix Spike duplicates replace duplicates for certain methods. Continuing calibration checks of the established calibration curves are included for the appropriate methods. When less than ten samples are analyzed in a group, a minimum of one fortified sample is analyzed.

All quality control monitoring is recorded on the appropriate quality control form, graph, or chart as required by the individual AESOPs. This data is filed and is available for internal inspection and assessment.

5.2.7 Performance System and Audits

The Quality Assessment program at Energy Laboratories includes performance evaluation samples, quality control check samples, and quality control audits.

Performance evaluation (PE) samples are supplied by an outside agency and contain known amounts of constituents. Typically the analyst does not have access to known values prior to the analysis. Results of the PE analyses are sent to the outside agency for evaluation. Established procedures must be followed regarding the timeliness of analysis and the return of results. Energy Laboratories participates in the U.S. Environmental Protection Agency Water Pollution Laboratory and Water Supply PE Studies.

Quality control reference samples may come from a commercial source or may be prepared in-house as required by the specific method. QC samples are processed through the system in the same manner as any other sample.

Energy Laboratories conducts internal Quality Control Audit inspections on a quarterly basis to monitor adherence to quality control requirements. Samples which have been previously submitted and reported are chosen at random for the audit. The audit checks sample tracking procedures, holding times, storage requirements, adherence to procedures during analysis, calculations completion of required quality control samples within the group surrounding the sample, and proper record keeping. The audit results are reported to management personnel with recommendations for corrective action if any discrepancies are found. A follow-up audit is conducted if necessary to determine that problems have been corrected.

5.2.8 Specific Procedures for Routine Data Assessment

The assessment of data includes data reduction, and validation, and a procedure for checking the data to be reported against that requested by the client and the data generated by the analysis. Several notebooks and records are vital to the procedures.

Energy Laboratories maintains several different types of notebooks including project notebooks, instrument/equipment use and maintenance logbooks, standard preparation logbooks, sample receipt logbooks, and a safety logbook. The general purpose of maintaining each of these notebooks is to record the activity details which may be pertinent to repeating a procedure, interpreting data, or documenting certain operations. It is the responsibility of each analyst to maintain a laboratory notebook.

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The analyst's notebook is particularly important in documenting analyses which deviate in any way from routine or standard practices.

Records of chemical analyses including all quality control records are kept by the laboratory for a minimum of five years. The records include chain-of-custody form, sample submittal and analysis dates, person responsible for performing analysis, analytical technique/method used, results of analysis, and quality control results, and a copy of the final report.

Corrective action is taken when quality control checks indicate that an analysis is not within the established control limits. The appropriate corrective action is dependent on the specific method and/or instrument. If a duplicate or spike analysis fails to fall within control limits, the analysis is repeated to verify that a problem exists. If the repeated analysis is not within control limits, the instrument and/or method procedure is checked according to specific protocols outlined in the AESOP and/or AMSOP. Once results are within control limits, analysis of all samples that were analyzed while the procedure was out of control are repeated. If the analyst is unable to achieve acceptable results after following the guidelines detailed in the AESOP and/or the AMSOP, supervision may determine that the instrument requires repair, or it is possible that the problems cannot be corrected to satisfy QC criteria. If all possible solutions are examined and the sample results appear to be valid, comments are attached to the sample report describing the non-compliance to QC and the probable cause. If A QC audit or other informational review shows an analysis report to be incorrect or incomplete, a written corrected report is submitted to the client with details of the correction, an explanation of the error and an assessment of the accuracy of the amended report.

Table 10
Specific Conductance Temperature Correction Factors, Calibration and Report Calculations

Temp (C)	Factor	Temp (C)	Factor	Temp (C)	Factor
-1	1.89	11	1.35	23	1.04
0	1.84	12	1.32	24	1.02
1	1.79	13	1.29	25	1.00
2	1.74	14	1.26	26	0.98
3	1.68	15	1.23	27	0.96
4	1.63	16	1.20	28	0.94
5	1.58	17	1.18	29	0.92
6	1.54	18	1.15	30	0.90
7	1.50	19	1.13	31	0.88
8	1.46	20	1.10	32	0.86
9	1.42	21	1.08		
10	1.38	22	1.06		

Date	Standard Sc (µmho/cm @ 25 C) (1)	Temp (C) (2)	Observed Sc (µmho/cm) (3)	Mode Scale (X__) (4)	Temp Correction Factor (5)	Corrected Sc (µmho/cm @ 25 C) (3)*(4)*(5)	Mode scale Cell Factor (1)/[(3)*(4)*(5)]	Initials
11/18/93	*147*	*26.5*	*156*	*1*	*0.97*	*151.32*	*0.971*	*DB*
11/18/93	*1413*	*26.5*	*140.0*	*10*	*0.97*	*1358*	*1.041*	*DB*

(1) Standard Sc, eg. 147, 1413, or 12,900 µmho/cm @ 25°C;
(2) Temperature of standard solution as read on the lower meter scale;
(3) Standard conductivity read on the upper meter scale (0 - 500)
(4) Scale factor, eg. 1, 10, or 100
(5) Temperature correction factor (See tabulated values above);

Date	Temp (C) (A)	Observed Sc (µmho/cm) (B)	Mode Scale (X__) (C)	Temp Correction Factor (D)	Mode Scale Cell Factor (E, see above)	Corrected Sc (µmho/cm @ 25 C) (B)*(C)*(D)*(E)	Initials
11/18/93	*16.0*	*130.0*	*10*	*1.20*	*1.041*	*1620*	*DB*

(A) Temperature of sample read on the lower meter scale
(B) Sample conductivity read on the upper meter scale (0 - 500)
(C) Scale factor, eg. 1, 10, or 100
(D) Temperature correction factor (See tabulated values above);
(E) Cell correction factor for appropriate scale, calculated as (1)/[(3)*(4)*(5)]

Table 11
Laboratory Calibration Procedures and Frequencies[1] by EPA Method Number

EPA Method	Calibration Procedures	Calibration Frequencies
8080	Five standard dilutions are used to generated a calibration curve. If curve verification is out of control, new standard solutions are prepared.	Calibration curve verified at least once per day to within ±10 %.
8150	Five standard dilutions are used to generated a calibration curve. If curve verification is out of control, new standard solutions are prepared.	Calibration curve verified at least once per day to within ±10 %.
8260	Stock standards are prepared at five concentration levels; Response factors are determined for each compound.	Stock standards prepared daily; Response factors verified to within ±25 % at least daily.
8270	Stock standards are prepared at five concentration levels; Response factors are determined for each compound; Internal standards added to all calibration standards and samples.	Stock standards prepared daily; Relative response factors verified to within ±25 % at least daily.
Sulfides by 9030; anions by 300 series; metals by 200 series	Calibration curves generated with blank and at least three standards; check standards, duplicates, and spiked samples are analyzed regularly.	Calibration curves generated for every hour of continuous analysis; QC samples run every 10 to 15 samples.
pH by 150.1;	Two buffer calibration to determine slope; single buffer calibration to correct for drift	Two buffer calibration daily; one buffer calibration every 2 hours.
Sc by 120.1;	Single standard calibration for each scale	Daily or as needed prior to use for each scale.
COD by 410.1	Two standard calibration with O_2 saturated and zero O_2 solutions	At least daily

[1] method guidelines, Energy Laboratories practices may differ.

6.0 SITE HEALTH AND SAFETY PLAN

No Site Health and Safety Plan is required at this time for the Laurel Landfill License #203. Hazardous levels of contaminants in ground water have not been encountered at the site. Should concentrations of pollutants approach hazardous levels, a Site Health and Safety Plan will be developed prior to the next sampling event or site visit. The Plan will stipulate that only persons with OSHA hazardous waste operations training will be allowed on site.

Health and safety precautions currently practiced at the Laurel Landfill include:

- New disposable gloves are required at each sampling site;
- Hard hats and steel toe shoes are required whenever drill rigs are on site;
- Well purge water is disposed of into drainages near the wells, not immediately adjacent to the well protective casing; and,
- Safety glasses or splash goggles are worn during sampling activities.

7.0 POST CLOSURE PLAN REVISIONS

As changes in the Final Cover Maintenance Plan, the Groundwater Monitoring Plan, the Groundwater Sampling and Analysis Plan, the Quality Assurance/Quality Control Plan, or the Site Health and Safety Plan become necessary due to changes in site conditions, regulations, detected constituents, monitoring well replacement or other changes, a written request will be submitted to the Montana Solid Waste Program for the proposed revisions. The MSWP may approve, deny, or modify the requested modifications. The revised portions of the Post Closure Plan will not be effective until approval is received by the City of Laurel from the MSWP. The Plan will be updated once every ten years at a minimum as required at ARM 16.14.707.

Each revised Post Closure Plan will be submitted to MSWP in its entirety with proposed additions denoted in redline and proposed deletions denoted in strikeout format. The revisions approved by MSWP will be incorporated and a complete Revised Post Closure Plan will be placed in the landfill operating record and on file with sampling personnel. Earlier editions of the Post Closure Plan will be labeled as "OBSOLETE."

GeoResearch recommends that revisions to this sampling plan be presented to MSWP for approval following MSWP acceptance of the final Hydrogeological and Soils Study, and upon evaluation of laboratory results from the spring 1994 groundwater sampling event.

It is recommended that an analysis of the minimum frequency, per ARM 16.14.706(4)(a) and 16.14.708(1)(d), the minimum number of analytes, per ARM 16.14.706(8) and 16.14.708(1)(b), and the smallest subset of wells, per ARM 16.14.708(1)(c), required to sufficiently monitor groundwater quality at the Laurel Landfill be initiated. It is also recommended that alternative enforcement standards per ARM 16.14.708(5)(d) and the necessity of remediation activities, per ARM 16.14.708(7)(e) be evaluated.

The recommended sampling schedule frequency and list of analytes for 1995 and subsequent years will be evaluated in light of this analysis and submitted to MSWP for approval prior to its initiation.

REFERENCES

Devore, Jay L., Probability and Statistics for Engineering and the Sciences, Brooks/Cole, pp. 343-393, 1982.

Energy Laboratories Analytical Services Catalog 1992, Revision 92.0.

Energy Laboratories Quality Assurance Program, Revision 92.1.

Energy Laboratories, Inc., letter to GeoResearch, January 17, 1994.

GeoResearch, Inc., Closure Plan City of Laurel Landfill, November 17, 1992.

GeoResearch, Inc., letter to Mr. Edward A. Thamke, Solid and Hazardous Waste Bureau, Department of Health and Environmental Sciences, December 31, 1992.

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Orion Research, Inc., Portable pH/ISE Meters Instruction Manual, the Schrafft Center, Boston, MA, 1991.

Solid Waste Program Montana Department of Health & Environmental Sciences, letter from Craig A. Stagner to Peggy Schram, Public Works Director City of Laurel, August 23, 1993.

Standish, John, Lab Director, Energy Laboratories, telefax communication to GeoResearch, Inc., December 3, 1993.

Test Methods for Evaluating Solid Waste Physical/Chemical Methods SW-846, EPA, Washington, DC, 1982.

Valkenburg, Cornelius A., Quality Assurance Officer, Energy Laboratories, telefax communication to GeoResearch, Inc., September 24, 1993.

APPENDIX A

Inspection and Repair Forms

GeoResearch

FORM 112001L____

ANNUAL COVER INSPECTION REPORT
LAUREL LANDFILL LICENSE #203

Date:______________ Weather Conditions:______________________________

Inspected by: name and initials:______________________________________

Item	Condition	Response Required	Date Response Implemented
Gate: lock sign			
Landfill Cap: erosion settling			
Vegetation: healthy washout			
Weeds: annual noxious			
West Ditch: erosion positive drainage			
West Fence: condition			
South Fence: condition			
East Ditch: erosion positive drainage			
East Fence: condition			
North Fence: condition			
North Drainage Swale: erosion positive drainage			

Comments:

MONITORING WELL INSPECTION REPORT
LAUREL LANDFILL LICENSE #203

Project Number: __________ Well Identification:____________________________

Date:____________________ Weather Conditions:____________________________

Inspected by: name and initials:____

Item	Condition	Response Required	Date Response Implemented
Protective Casing			
Locking Cap			
Padlock			
Concrete Pad			
PVC riser cap			
PVC riser			
Measuring point			
Measured Depth			
Odor	None Sulfur Gas/Oil ______		

Comments:

FORM 112003L____

REPAIR RECORD
LAUREL LANDFILL LICENSE #203

Location:______________________________

Date:__________________ Weather Conditions:__________________

Repaired by: name and initials:______________________________

Repair Time	Repairer's Initials	Description of Repair Activities

APPENDIX B

Well Completion Logs

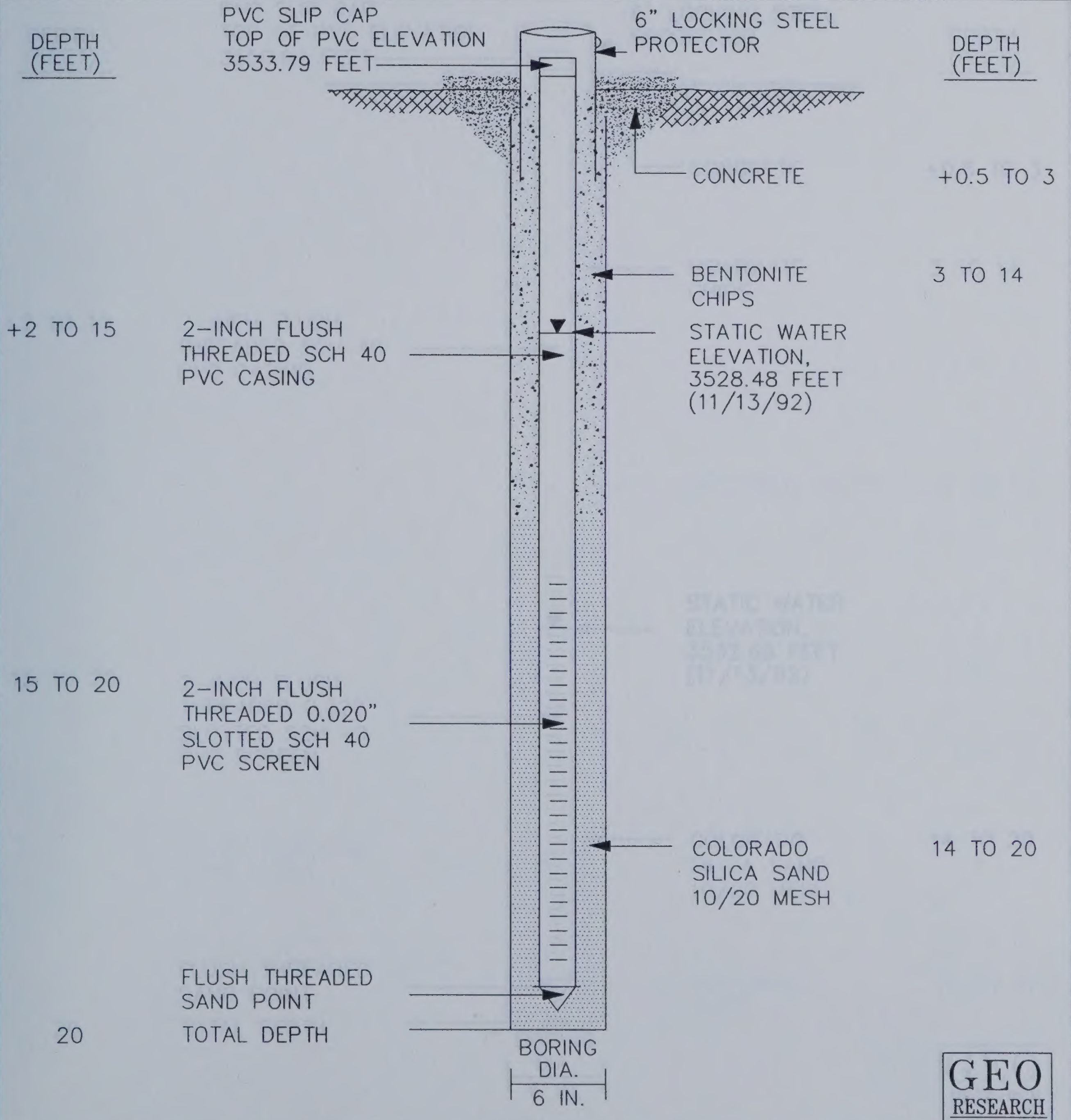
MONITORING WELL COMPLETION LOG

PROJECT 112035
SITE LAUREL LANDFILL
LOCATION SEE MAP

HYDROGEOLOGIST CURT COOVER
DRILLER PRO PUMP

DATE OCTOBER 27, 1992

HOLE I.D.
MW-1


DEPTH (FEET)
PVC SLIP CAP
TOP OF PVC ELEVATION 3533.79 FEET
6" LOCKING STEEL PROTECTOR
DEPTH (FEET)
CONCRETE
+0.5 TO 3
BENTONITE CHIPS
3 TO 14
+2 TO 15
2-INCH FLUSH THREADED SCH 40 PVC CASING
STATIC WATER ELEVATION, 3528.48 FEET (11/13/92)
15 TO 20
2-INCH FLUSH THREADED 0.020" SLOTTED SCH 40 PVC SCREEN
COLORADO SILICA SAND 10/20 MESH
14 TO 20
FLUSH THREADED SAND POINT
20
TOTAL DEPTH
BORING DIA.
6 IN.

GEO RESEARCH

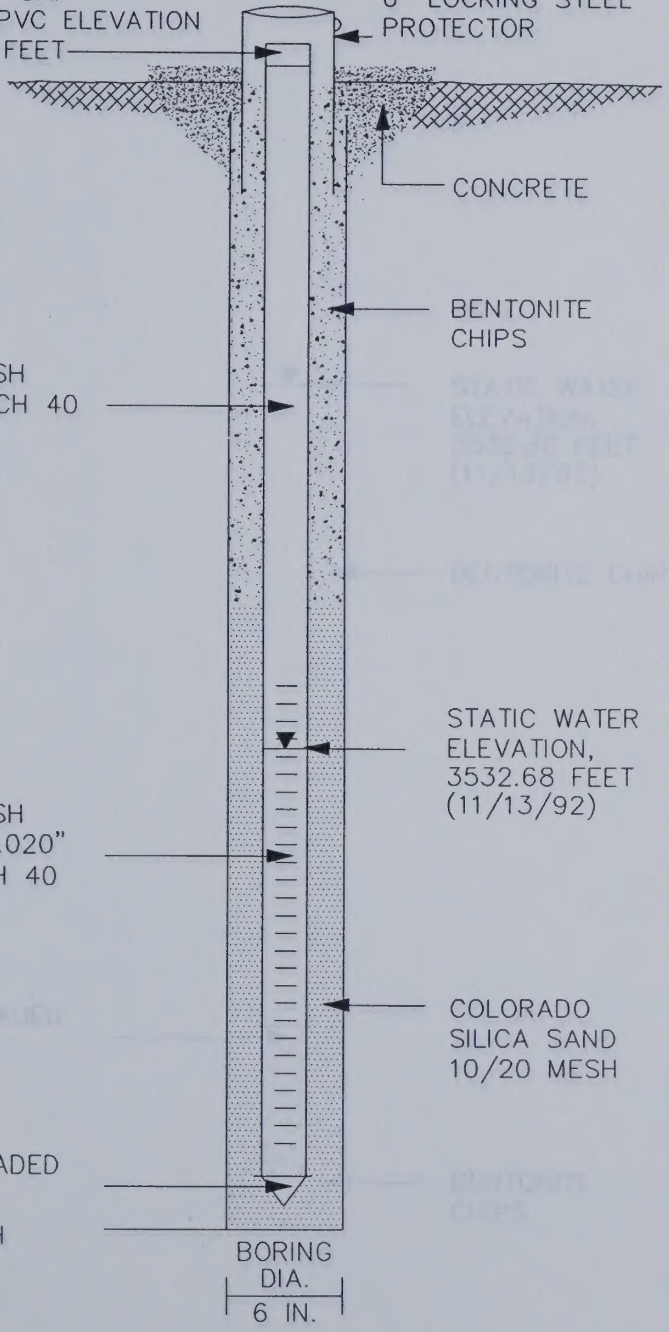
MONITORING WELL COMPLETION LOG

PROJECT 112035
SITE LAUREL LANDFILL
LOCATION SEE MAP

HYDROGEOLOGIST CURT COOVER
DRILLER PRO PUMP

DATE OCTOBER 27, 1992

HOLE I.D.
MW-2



PVC SLIP CAP
TOP OF PVC ELEVATION
3550.94 FEET

6" LOCKING STEEL PROTECTOR

STATIC WATER ELEVATION, 3532.68 FEET (11/13/92)

DEPTH (FEET)			DEPTH (FEET)
		CONCRETE	+0.5 TO 3
		BENTONITE CHIPS	3 TO 14
+2 TO 15	2-INCH FLUSH THREADED SCH 40 PVC CASING		
15 TO 20	2-INCH FLUSH THREADED 0.020" SLOTTED SCH 40 PVC SCREEN		
		COLORADO SILICA SAND 10/20 MESH	14 TO 20
	FLUSH THREADED SAND POINT		
20	TOTAL DEPTH		

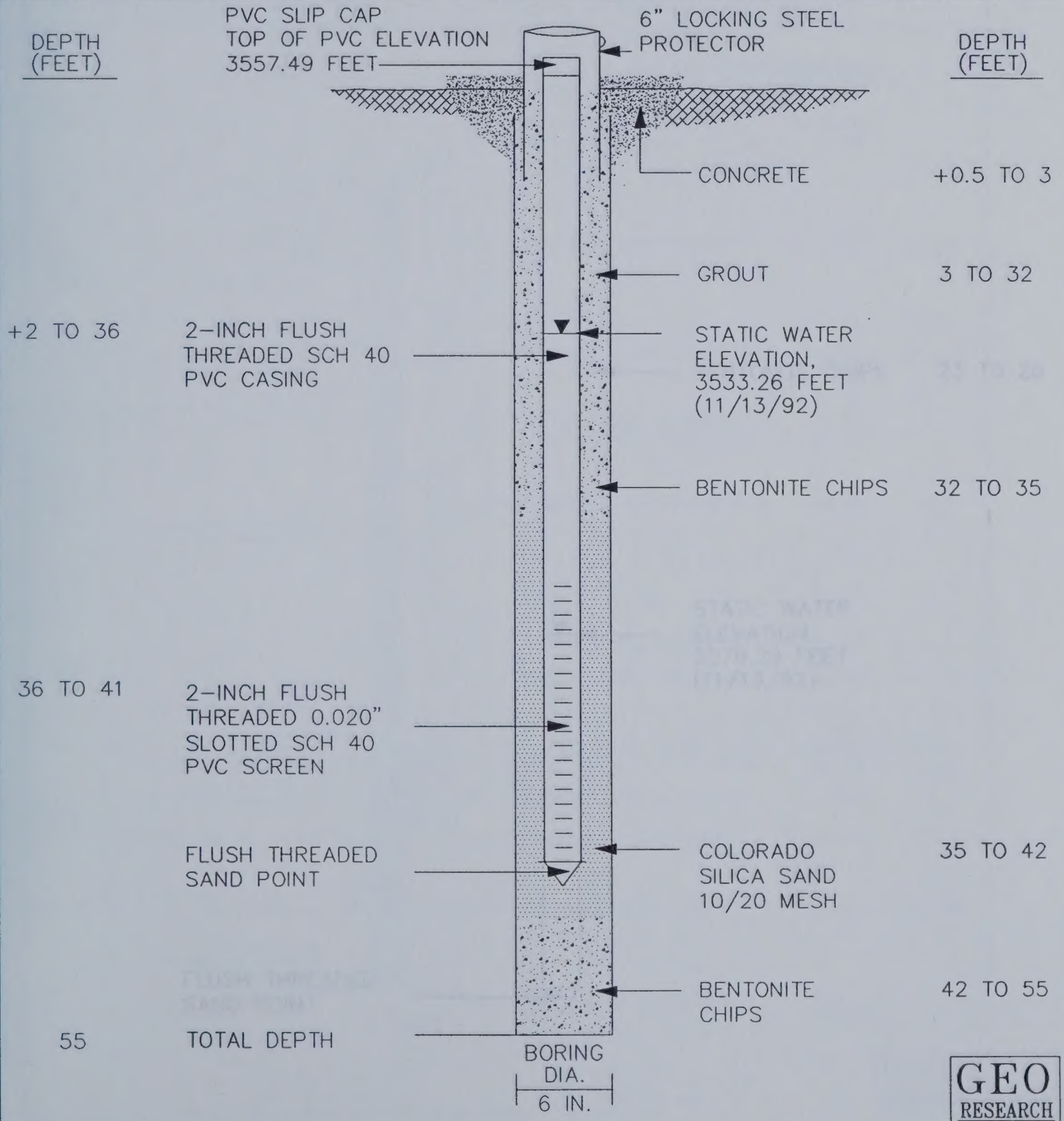
GEO
RESEARCH

MONITORING WELL COMPLETION LOG

PROJECT 112035
SITE LAUREL LANDFILL
LOCATION SEE MAP

HYDROGEOLOGIST CURT COOVER
DRILLER PRO PUMP
DATE OCTOBER 28, 1992

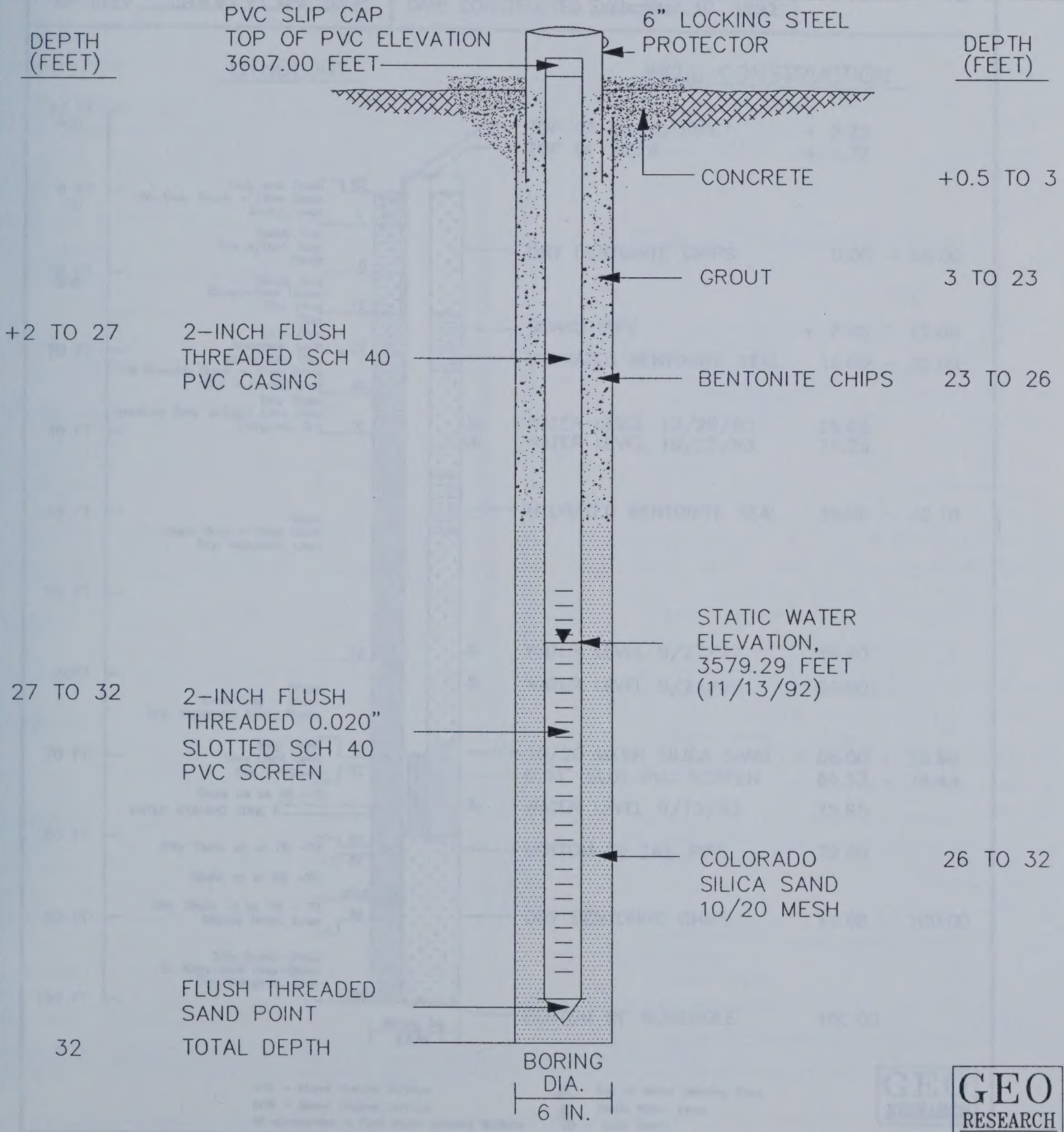
HOLE I.D.
MW-3


DEPTH (FEET)
PVC SLIP CAP
TOP OF PVC ELEVATION
3557.49 FEET
6" LOCKING STEEL PROTECTOR
DEPTH (FEET)
CONCRETE
+0.5 TO 3
GROUT
3 TO 32
+2 TO 36
2-INCH FLUSH THREADED SCH 40 PVC CASING
STATIC WATER ELEVATION, 3533.26 FEET (11/13/92)
BENTONITE CHIPS
32 TO 35
36 TO 41
2-INCH FLUSH THREADED 0.020" SLOTTED SCH 40 PVC SCREEN
FLUSH THREADED SAND POINT
COLORADO SILICA SAND 10/20 MESH
35 TO 42
BENTONITE CHIPS
42 TO 55
55
TOTAL DEPTH
BORING DIA.
6 IN.

GEO RESEARCH

MONITORING WELL COMPLETION LOG

PROJECT 112035 SITE LAUREL LANDFILL LOCATION SEE MAP	HYDROGEOLOGIST CURT COOVER DRILLER PRO PUMP DATE OCTOBER 28, 1992	HOLE I.D. MW-4


DEPTH (FEET)
PVC SLIP CAP
TOP OF PVC ELEVATION 3607.00 FEET
6" LOCKING STEEL PROTECTOR
DEPTH (FEET)
CONCRETE
+0.5 TO 3
GROUT
3 TO 23
+2 TO 27
2-INCH FLUSH THREADED SCH 40 PVC CASING
BENTONITE CHIPS
23 TO 26
STATIC WATER ELEVATION, 3579.29 FEET (11/13/92)
27 TO 32
2-INCH FLUSH THREADED 0.020" SLOTTED SCH 40 PVC SCREEN
COLORADO SILICA SAND 10/20 MESH
26 TO 32
FLUSH THREADED SAND POINT
32
TOTAL DEPTH
BORING DIA.
6 IN.

GEO RESEARCH

LITHOLOGY AND WELL COMPLETION LOG

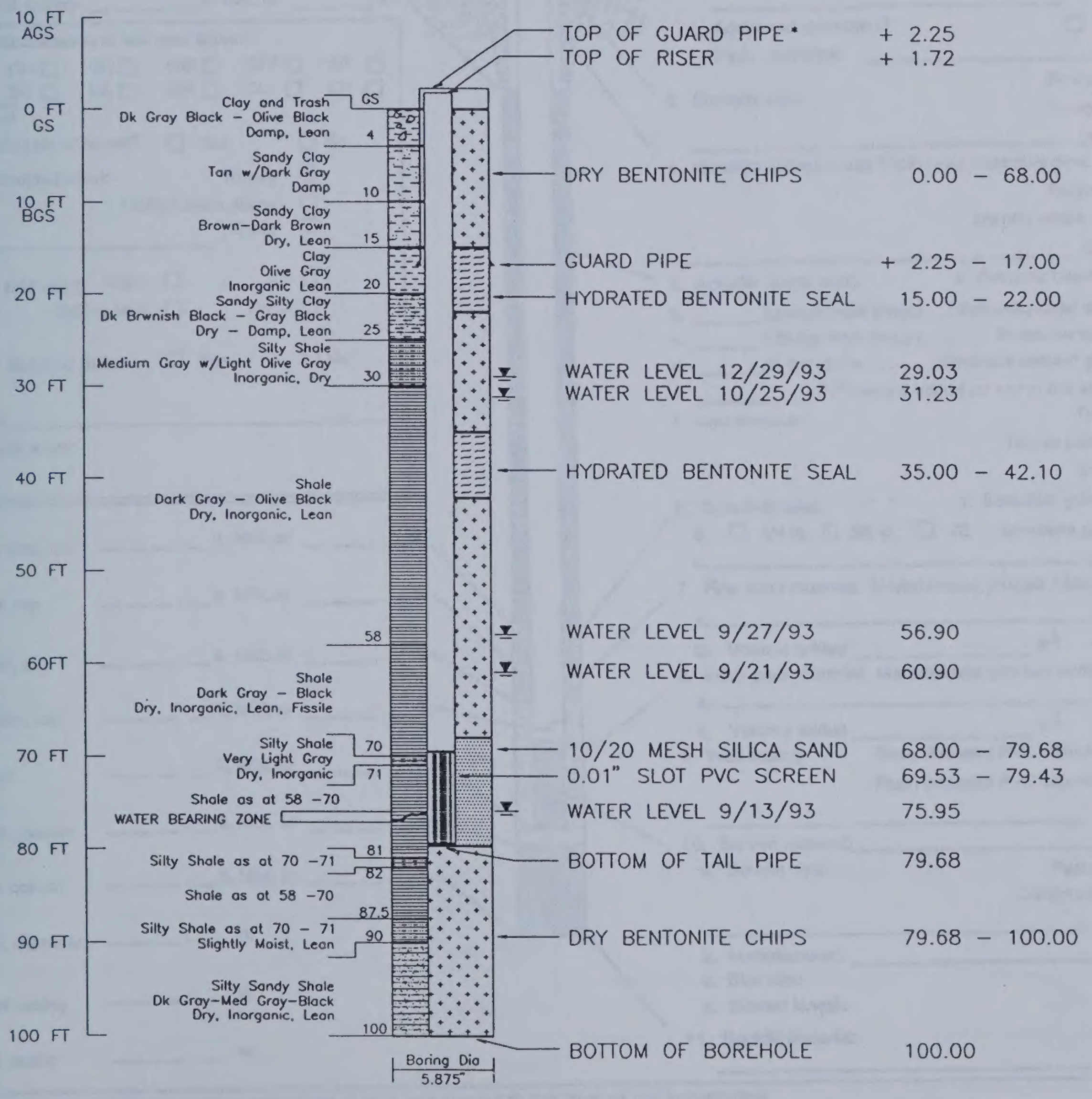
PROJECT NUMBER 112035
SITE LAUREL LANDFILL
LOCATION NW S33 T1S R24E
YELLOWSTONE COUNTY, MT
MP ELEV 3549.93 FT MSL TOGP*

SUPERVISOR J. D. SHAFFER
GEORESEARCH, INC
DRILLER ADT PRO PUMP
DATE DRILLED September 10, 1993
DATE CONSTRUCTED September 10, 1993

BORE HOLE
93MW-2D

LITHOLOGY

WELL CONSTRUCTION



10 FT AGS
0 FT GS
10 FT BGS
20 FT
30 FT
40 FT
50 FT
60FT
70 FT
80 FT
90 FT
100 FT
GS
Clay and Trash
Dk Gray Black – Olive Black
Damp, Lean
4
Sandy Clay
Tan w/Dark Gray
Damp
10
Sandy Clay
Brown–Dark Brown
Dry, Lean
15
Clay
Olive Gray
Inorganic Lean
20
Sandy Silty Clay
Dk Brwnish Black – Gray Black
Dry – Damp, Lean
25
Silty Shale
Medium Gray w/Light Olive Gray
Inorganic, Dry
30
Shale
Dark Gray – Olive Black
Dry, Inorganic, Lean
58
Shale
Dark Gray – Black
Dry, Inorganic, Lean, Fissile
Silty Shale
Very Light Gray
Dry, Inorganic
70
71
Shale as at 58 –70
WATER BEARING ZONE
81
Silty Shale as at 70 –71
82
Shale as at 58 –70
87.5
Silty Shale as at 70 – 71
Slightly Moist, Lean
90
Silty Sandy Shale
Dk Gray–Med Gray–Black
Dry, Inorganic, Lean
100
Boring Dia
5.875"

TOP OF GUARD PIPE *	+ 2.25
TOP OF RISER	+ 1.72
DRY BENTONITE CHIPS	0.00 – 68.00
GUARD PIPE	+ 2.25 – 17.00
HYDRATED BENTONITE SEAL	15.00 – 22.00
WATER LEVEL 12/29/93	29.03
WATER LEVEL 10/25/93	31.23
HYDRATED BENTONITE SEAL	35.00 – 42.10
WATER LEVEL 9/27/93	56.90
WATER LEVEL 9/21/93	60.90
10/20 MESH SILICA SAND	68.00 – 79.68
0.01" SLOT PVC SCREEN	69.53 – 79.43
WATER LEVEL 9/13/93	75.95
BOTTOM OF TAIL PIPE	79.68
DRY BENTONITE CHIPS	79.68 – 100.00
BOTTOM OF BOREHOLE	100.00

AGS – Above Ground Surface
BGS – Below Ground Surface
All dimensions in Feet Below Ground Surface

▽ Top of Water Bearing Zone
▼ Static Water Level
TD – Total Depth

GEO
RESEARCH

State of Montana
Department of Health
and Environmental Sciences

Route to: Solid Waste ☐

MONITORING WELL CONSTRUCTION

Facility/Project Name

Local Grid Location of Well
________ ft ☐ N ☐ S ________ ft ☐ E ☐ W

Well Name

Facility License

Grid Origin Location
Lat. ____ ____ ____ Long. ____ ____ ____ or
St. Plane ________ ft N ________ ft S

MT Unique Well Number DHES Well Name

Type of Well Water Table Observation Well ☐ 11
Piezometer ☐ 12

Section Location of Waste/Source ☐ E ☐ W

Date Well Installed __ __ / __ __ / __ __
mm dd yy

Distance Well Is From Waste/Source Boundary ft

Well Installed By: (Person's Name and Firm)

Is Well a Point of Standards Application? ☐ Yes ☐ No

Location of Well Relative to Waste/Source
u ☐ Upgradient s ☐ Sidegradient
d ☐ Downgradient n ☐ Not Known

Monitoring Well Constructor License Number

A. Protective pipe, top elevation ____ . ____ ft. MSL

B. Well casing, top elevation ____ . ____ ft. MSL

C. Land Surface elevation ____ . ____ ft. MSL

D. Surface seal, bottom ____ . __ ft. MSL or ____ . __ ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ GW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☐ No

14. Drilling method used: Rotary ☐
Hollow Stem Auger ☐
Other ☐
____

15. Drilling fluid used: Water ☐ Air ☐
Drilling Mud ☐ None ☐

16. Drilling additives used? ☐ Yes ☐ No

Describe ________________

17. Source of water:
____

E. Bentonite seal, top ____ . __ ft. MSL or ____ . __ ft.

F. Fine sand, top ____ . __ ft. MSL or ____ . __ ft.

G. Filter pack, top ____ . __ ft. MSL or ____ . __ ft.

H. Screen joint, top ____ . __ ft. MSL or ____ . __ ft.

I. Well bottom ____ . __ ft. MSL or ____ . __ ft.

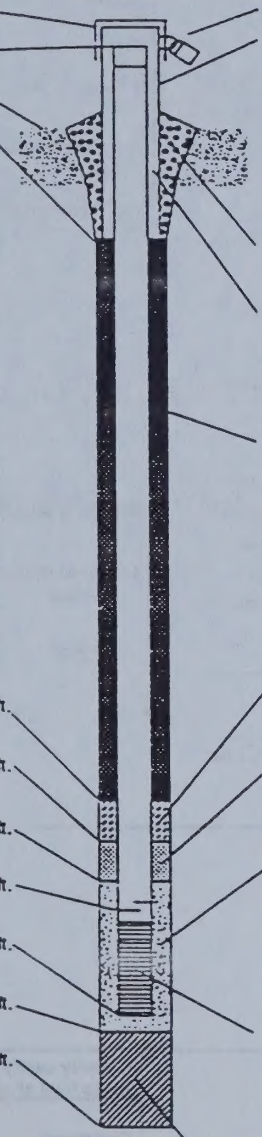
J. Filter pack, bottom ____ . __ ft. MSL or ____ . __ ft.

K. Borehole bottom ____ . __ ft. MSL or ____ . __ ft.

L. Borehole, diameter ____ . __ in.

M. O.D. well casing ____ . __ in.

N. I.D. well casing ____ . __ in.



1. Cap and lock? ☐ Yes ☐ No

2. Protective cover pipe:
   a. Inside diameter: __ . _ in.
   b. Length: __ . _ ft.
   c. Material: Steel ☐
   ________________ Other ☐
   d. Additional protection? ☐ Yes ☐
   If yes, describe: ________________

3. Surface seal: Bentonite ☐
   Concrete ☐
   ________________ Other ☐

4. Material between well casing and protective pipe:
   Bentonite ☐
   Annular space seal ☐
   ________________ Other ☐

5. Annular space seal: a. Granular bentonite ☐
   b. ______ Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. ______ Lbs/gal mud weight . . . Bentonite slurry ☐
   d. ______ % bentonite . . . . Bentonite cement grout ☐
   e. ______ Ft^3 volume added for any of the above
   f. How installed: Tremie ☐
   Tremie pumped ☐
   Gravity ☐

6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2. Bentonite pellets ☐
   c. ________________ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
   a. ________________
   b. Volume added ________ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
   a. ________________
   b. Volume added ________ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐
   Flush threaded PVC schedule 80 ☐
   ________________ Other ☐

10. Screen material: ________________
   a. Screen type: Factory cut ☐
   Continuous slot ☐
   ________________ Other ☐
   b. Manufacturer: ________________
   c. Slot size: 0.___ in.
   d. Slotted length: __ . _ ft.

11. Backfill material:
   ________________ None ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm

State of Montana
Department of Health
and Environmental Sciences

Route to: Solid Waste ☐

MONITORING WELL DEVELOPMENT

Facility/Project Name	County Name	Well Name	
Facility License Number __ __ __ __ __ __	County Code __ __	MT Unique Well Number __ __ __ __ __	DHES Well Number __ __
Well Installed By: (Person's Name and Firm)		Monitoring Well Constructor License Number	

1. Can this well be purged dry? ☐ Yes ☐ No

2. Well development method
   - surged with bailer and bailed ☐
   - surged with bailer and pumped ☐
   - surged with block and bailed ☐
   - surged with block and pumped ☐
   - surged with block, bailed and pumped ☐
   - compressed air ☐
   - bailed only ☐
   - pumped only ☐
   - pumped slowly ☐
   - Other ______________________ ☐

3. Time spent developing well ________ min.

4. Depth of well (from top of casing) ____.__ ft.

5. Inside diameter of well ____.__ in.

6. Volume of water in filter pack and well casing ____.__ gal.

7. Volume of water removed from well ____.__ gal.

8. Volume of water added (if any) ____.__ gal.

9. Source of water added ______________________

10. Analysis performed on water added? ☐ Yes ☐ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. ____.___ ft.	____.___ ft.
Date	b. __ __/__ __/__ __ m m d d y y	__ __/__ __/__ __ m m d d y y
Time	c. __ __:__ __ ☐ a.m. ☐ p.m.	__ __:__ __ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.__ inches	___.__ inches
13. Water clarity	Clear ☐ Turbid ☐ (Describe)	Clear ☐ Turbid ☐ (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____.__ mg/l	____.__ mg/l
15. COD	____.__ mg/l	____.__ mg/l

16. Additional comments on development

Well developed by: (Person's Name and Firm)

Name: ______________________

Firm: ______________________

I hereby certify that the above information is true and correct to the best of my knowledge

Signature: ______________________

Print Initials: __ __ __

Firm: ______________________

Note: Shaded areas are for DHES use only. See instructions for more information including a list of county codes.

APPENDIX C

Groundwater Sampling Field Log Book Forms

GeoResearch FORM 112104F.____

FIELD OBSERVATIONS
LAUREL LANDFILL
GeoResearch Project Number 112035

Page___of___

Date:_______________ Weather Conditions:______________________________

Observed by: name and initials:____

Time	Location	Field Observations

GeoResearch

FORM 112105F.___

VARIANCE RECORD
LAUREL LANDFILL
GeoResearch Project Number 112035

Page___of___

Date:____________ Weather Conditions:______________________________

Name and Initials:____

Date	Location	Description of Variance Activities and Justification

SAMPLING ACTIVITIES IN CHRONOLOGICAL ORDER
LAUREL LANDFILL
GeoResearch Project Number 112035

Forms Comprising Field Log Book:

- Map of Site
- 5 of 112002I
- 5 of 112104F
- 5 of 112105F
- 1 of 112206C
- 1 of 112207C
- Sampling Activities in Chronological Order
- 2 of 112208C
- 1 of 112209C
- 1 of 112310S
- 8 of 112311S
- 1 OF 112312S
- 1 OF 112313S

Order of Sampling	ID Number	Detection Monitoring	Assessment Monitoring
1	MW-4	Volatile Organics	Volatile Organics
2	MW-3	Nitrate and COD	Semi-volatiles, PCBs, pesticides, herbicides,
3	MW-1	Cyanide	Cyanide
4	93MW-2D	Major anions and General Parameters	Sulfide
5	MW-2	Dissolved Metals (field filtered)	Dissolved Metals (field filtered)

A) Calibrate well probe and temperature sensors;
B) Measure depth to water in all wells, decontaminate probe between wells;
C) Calibrate specific conductivity and pH meters;
D) At each well sampling site:

1) Transport all appropriate equipment to the well sampling site;
2) Decontaminate equipment;
3) Calibrate pH meter;
4) Inspect well;
5) Determine static water height;
6) Calculate water column volume;
7) Don clean gloves;
8) Evacuate well;
9) Withdraw sample;
    a) Use bailers, containers, and preservatives, Tables 3 and 4;
    b) Label each sample container;
    c) Add preservative to sample container;
    d) Triple rinse each bailer with sample prior to use;
    e) Withdraw volumes for sample portions shown in Tables 3 and 4;
    f) Field filter dissolved metals portion before containerizing.
        i) Triple rinse apparatus with 10 ml of sample water;
        ii) Empty catch flask after each rinse;
        iii) Place approximately 260 ml sample in funnel;
        iv) Apply vacuum to catch flask using hand vacuum pump; and,
10) Measure field parameters;
    a) Record temperature on pH meter as soon as stabilized;
    b) Record pH as soon as stabilized;
    c) Record temperature from S-C-T meter temperature as soon as stabilized;
    d) Turn mode to X100 scale on S-C-T meter. If reading is below 50, place meter in X10 scale mode. Record scale mode and SC reading
11) Collect well recharge data.

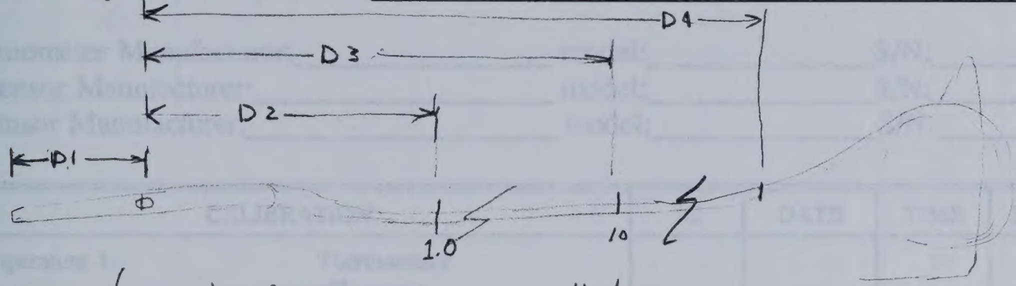
GeoResearch

FORM 112206C.___

WELL PROBE PREPARATION AND CALIBRATION
LAUREL LANDFILL LICENSE #203
GeoResearch Project Number 112035

Date:______________ Calibration Location:______________________________

Calibrated by: name and initials:______________________________________



(a drafted drawing will be ready for the final draft) MMH

Equipment Manufacturer:______________ model:______________ S/N:__________

PRE-CALIBRATION	FEET	DATE	TIME	INITIALS
Auditory Signal: Yes No	-		:	
Visual Signal: Yes No	-		:	
Ambient Temperature: °F	-		:	
D1 = Probe Tip to Depth Sensor			:	
D2 = Probe Sensor to 1-foot Gradation on Cable			:	
D3 = Probe Sensor to 10 foot Gradation on Cable			:	
D4 = Probe Sensor to ___ foot Gradation on Cable			:	

Calibration Correction Factor: D1: D2: D3: D4:

POST-CALIBRATION	FEET	DATE	TIME	INITIALS
Auditory Signal: Yes No	-		:	
Visual Signal: Yes No	-		:	
Ambient Temperature: °F	-		:	
D1 = Probe Tip to Depth Sensor			:	
D2 = Probe Sensor to 1-foot Gradation on Cable			:	
D3 = Probe Sensor to 10-foot Gradation on Cable			:	
D4 = Probe Sensor to ___-foot Gradation on Cable			:	

Calibration Correction Factor: D1: D2: D3: D4:

GeoResearch FORM 112207C.____

TEMPERATURE SENSOR CALIBRATION
LAUREL LANDFILL LICENSE #203
GeoResearch Project Number 112035

Date:________________ Calibration Location:________________________

Calibrated by: name and initials:________________________________

Thermometer Manufacturer:________________ model:______________S/N:__________

pH sensor Manufacturer:________________ model:______________S/N:__________

Sc sensor Manufacturer:________________ model:______________S/N:__________

CALIBRATION		°C	DATE	TIME	INITIALS
Temperature 1:	Thermometer			:	
	pH sensor			:	
	Sc sensor			:	
Temperature 2:	Thermometer			:	
	pH sensor			:	
	Sc sensor			:	
Temperature 3:	Thermometer			:	
	pH sensor			:	
	Sc sensor			:	

Thermometer Manufacturer:________________ model:______________S/N:__________

pH sensor Manufacturer:________________ model:______________S/N:__________

Sc sensor Manufacturer:________________ model:______________S/N:__________

CALIBRATION		°C	DATE	TIME	INITIALS
Temperature 1:	Thermometer			:	
	pH sensor			:	
	Sc sensor			:	
Temperature 2:	Thermometer			:	
	pH sensor			:	
	Sc sensor			:	
Temperature 3:	Thermometer			:	
	pH sensor			:	
	Sc sensor			:	

GeoResearch

FORM 112208C.____

SPECIFIC CONDUCTANCE METER CALIBRATION
LAUREL LANDFILL LICENSE #203
GeoResearch Project Number 112035

Date:__________Calibrated by: name and initials______________________________

Equipment Manufacturer:________________model:______________S/N:______________

SPECIFIC CONDUCTANCE TEMPERATURE FACTORS									
Temp (°C)	Factor (TF)	Temp (°C)	Factor (TF)	Temp (°C)	Factor (TF)	Temp (°C)	Factor (TF)	Temp (°C)	Factor (TF)
-1	1.89	6	1.54	13	1.29	20	1.10	27	0.96
0	1.84	7	1.50	14	1.26	21	1.08	28	0.94
1	1.79	8	1.46	15	1.23	22	1.06	29	0.92
2	1.74	9	1.42	16	1.20	23	1.04	30	0.90
3	1.68	10	1.38	17	1.18	24	1.02	31	0.88
4	1.63	11	1.35	18	1.15	25	1.00	32	0.86
5	1.58	12	1.32	19	1.13	26	0.98	33	0.84

Zero Adjustment: left right Red Line Adjustment: left right Replace Batteries: Yes No

X100 SCALE CELL FACTOR DETERMINATION	Value	Date	Time	Initials
SCS = Standard Sc µmho/cm @ 25°C Expiration Date:__________			:	
Temperature of Standard °C			:	
TF = Temperature Factor (Table above)			:	
MS = Mode Scale	X_______		:	
OSC = Observed Sc (0 to 500) µmho/cm			:	
CTOSC = Cell Test Observed Sc (0 to 500) µmho/cm % drop = (OSC - CTOSC) x 100/OSC				
CSC = Corrected Sc = TF x OSC x MS µmho/cm @ 25°C			:	
CF = Cell Factor = SCS/CSC			:	

X10 SCALE CELL FACTOR DETERMINATION	Value	Date	Time	Initials
SCS = Standard Sc µmho/cm @ 25°C Expiration Date:____________			:	
Temperature of Standard °C			:	
TF = Temperature Factor (Table above)			:	
MS = Mode Scale	X_______		:	
OSC = Observed Sc (0 to 500) µmho/cm			:	
CTOSC = Cell Test Observed Sc (0 to -500) µmho/cm % drop = (OSC - CTOSC) x 100/OSC				
CSC = Corrected Sc = TF x OSC x MS µmho/cm @ 25°C			:	
CF = Cell Factor = SCS/CSC			:	

GeoResearch

FORM 112209C.____

pH METER PREPARATION AND CALIBRATION
LAUREL LANDFILL LICENSE #203
GeoResearch Project Number 112035

Date:__________Calibrated by: name and initials________________________________

Equipment Manufacturer:_______________model:_______________S/N:_____________

Buffer Expiration Date:_pH 4:_______________pH 7:_______________pH 10:_______________

Cotton in Electrode Slip Cover: Wet Dry Storage Solution Added: Yes No

Filling Solution Level Above Junction: __________in. Added Filling Solution: Yes No

POWERUP and CHECKOUT			DATE	TIME	INITIALS
Battery Indicator:	OK	LOW		:	
9 Volt Battery Replaced:	No	Yes			
Power Up Checkout:	Ready	Error		:	
Return meter to Manufacturer: Date:______________				:	
Set-up Parameters: Default	Setting			:	
1-1 Ready:	On			:	
1-2 Hold:	Off			:	
1-3 Beep:	On			:	
1-4 Auto shutoff:	On			:	
2-1 Slope:	100.0	------		:	
3-1 Timer Interval:	H 00			:	
	00:05			:	
3-2 Time Remaining:	00:00			:	

CALIBRATIONS			DATE	TIME	INITIALS
TWO POINT CALIBRATION: (DAILY)	Sleeve position: up	down		:	
	4 buffer: actual pH________			:	
	7 buffer: actual pH________			:	
	10 buffer: actual pH________			:	
	SLOPE:________________			:	
SINGLE POINT CALIBRATION: (EVERY 2 HOURS)	Sleeve position: up	down		:	
	4 buffer: actual pH________			:	
	7 buffer: actual pH________			:	
	10 buffer: actual pH________			:	
SINGLE POINT CALIBRATION: (EVERY 2 HOURS)	Sleeve position: up	down		:	
	4 buffer: actual pH________			:	
	7 buffer: actual pH________			:	
	10 buffer: actual pH________			:	
SINGLE POINT CALIBRATION: (EVERY 2 HOURS)	Sleeve position: up	down		:	
	4 buffer: actual pH________			:	
	7 buffer: actual pH________			:	
	10 buffer: actual pH________			:	
SINGLE POINT CALIBRATION: (EVERY 2 HOURS)	Sleeve position: up	down		:	
	4 buffer: actual pH________			:	
	7 buffer: actual pH________			:	
	10 buffer: actual pH________			:	
SINGLE POINT CALIBRATION: (EVERY 2 HOURS)	Sleeve position: up	down		:	
	4 buffer: actual pH________			:	
	7 buffer: actual pH________			:	
	10 buffer: actual pH________			:	

GeoResearch

FORM 112310S.___

SAMPLING EQUIPMENT CHECKLIST FORM
LAUREL LANDFILL LICENSE #203
GeoResearch Project Number 112035

Date:___ Form Prepared by: name and initials___

- ___ Ice
- ___ Field Log Book
- ___ Site Log Book

- ___ Chronologic activities
- ___ Sample portion definition
- ___ Completion logs for wells of concern
- ___ Well key
- ___ Gate access key
- ___ Calculator
- ___ Waterproof field book
- ___ Waterproof pen
- ___ Magic marker
- ___ Watch
- ___ Custody seals
- ___ Chain of custody form(s)
- ___ Clear tape

- ___ Submersible pump
- ___ Pump control box
  - ___ Electric generator
  - ___ Electrical cord 25-50 feet
  - ___ 100 ft Poly rope w/link

- ___ Stainless steel bailer
- ___ PVC sample bailer w/link
- ___ 2" Purge bailer w/link
- ___ Rope
- ___ 5-gallon buckets (3)
- ___ Chain with "S" hook

- ___ 10% Nitric acid
- ___ Methanol
- ___ Liquinox
- ___ De-Ionized water (2 gallons) **for metals**

- ___ Potable water (10 gallons) for pre-rinse
- ___ Distilled water (5-gallons) **for VOCs**
- ___ Brushes, long handle and short handle
- ___ Paper towels
- ___ Spray bottles (3)
- ___ Disposable gloves
- ___ Heavy plastic gloves
- ___ 6-mil poly sheeting
- ___ Aluminum foil

- ___ pH meter with extra batteries (9-volt)
  - ___ 4, 7, 10 buffers

- ___ Specific conductance meter with extra batteries (2 D cells)
  - ___ 147, 1413, 12,900 standards

- ___ Water level meter with extra battery (9-volt)
- ___ 1-liter wide mouth glass bottles (3)

- ___ Cooler with ice
- ___ Filtration unit
- ___ Filters
  - ___ Tygon tubing

- ___ 1-liter wide mouth glass bottle
- ___ Sample bottles
- ___ Duplicate sample bottles
- ___ Equipment blank bottles

- ___ Preservatives (samples plus QA/QC)

- ___ Sample labels

- ___ Hard hat(s)
- ___ Safety glasses
- ___ Long sleeve shirt
- ___ Steel toe boots
- ___ Coveralls (Tyvek)
- ___ Leather gloves
- ___ Sun screen
- ___ Drinking water
- ___ Paper cups
- ___ Flashlight w/ batteries (2 D cells)
- ___ First Aid kit

- ___ Tool box
  - ___ Steel tape
  - ___ Hammer
  - ___ Pliers
  - ___ Knife
  - ___ Crescent wrench
  - ___ Vise grips
  - ___ Duct tape

GeoResearch

FORM 112311S.____

WELL PURGING AND SAMPLING INFORMATION FORM
LAUREL LANDFILL LICENSE #203
GeoResearch Project Number 112035

SAMPLE ID#: ______________________ **WELL ID:** ______________________

SAMPLER NAME & INITIALS: ______________________ **SAMPLER NAME & INITIALS:** ______________________

WEATHER CONDITIONS: Temp.: ______°F Sunny Cloudy Drizzle Rainy Windy Snowing Other: ______________________

SAMPLE TYPE: Original Duplicate Blank (Field, Trip) Equipment Rinse Matrix Spike Other: ______________________

DECONTAMINATION: ____ Well Probe ____ SS bailer ____ PVC bailer ____ Field Parameter Jar ____ Filtration Equip ____pH Probe ____Sc Probe ____Other__________

LEVEL MEASURING POINT (Describe): ______________________

WATER LEVEL CALCULATIONS	FEET	DATE	TIME	INITIALS
MWD = Measured Well Depth			:	
MWLD = Measured Water Level Depth (Before Purging)			:	
SWH = Static Water Height = MWD - MWLD			:	

WELL PURGING	---	DATE	TIME	INITIALS
D = Casing/Riser Diameter	in.		:	
WWV = Water Well Volume = SWH x 0.163 x [D/2]^2	gals		:	
MPV = Minimum Purge Volume = 3 x WWV	gals		:	
Actual Purge Volume: __________ gallons	Start		:	
Well Purged Dry? YES / NO	Stop		:	

PURGE METHOD: Bailer: (PVC TEFLON Stainless) Pump: (Bladder Sump Submersible) Pump ID# ______________________
SAMPLE METHOD: Bailer: (PVC TEFLON Stainless) Pump: (Bladder Sump Submersible) Pump ID# ______________________
SAMPLE COLOR: Clear Cloudy Black Grey Green Yellow Brown Tan Other: ______________________
SAMPLE ODOR: None Metallic Gas/Diesel Sulphur Other: ______________________

WELL RECHARGE		FEET	DATE	TIME	INITIALS
MWLD(b) Immediately Before Sampling				:	
MWLD(s) Immediately After Sampling				:	
$MWLD(d_1)$ During Equip. Decon.	(1st reading)			:	
$MWLD(d_2)$ During Equip. Decon.	(2nd reading)			:	
$MWLD(d_3)$ During Equip. Decon.	(3rd reading)			:	
$MWLD(d_4)$ During Equip. Decon.	(4th reading)			:	
WRR = Well Recharge Rate	$\frac{[MWLD(s) - MWLD(d\ \ )] \times 0.163 \times [D/2]^2}{Time(d\_\_) - Time(s)}$	______ gals/min		:	

FIELD PARAMETERS (MEASURED IN: WELL / SURFACE)												
TEMP.	pH		CONDUCTIVITY			TURBIDITY				DATE	TIME	INITIALS
°C	SU	°C	µmho/cm	Range	°C	ntu	Range			---	---	---
											:	
											:	

EQUIPMENT CALIBRATIONS					
METER TYPE	MANUFACTURER	MODEL & S/N	DATE	TIME	INITIALS
Well Probe				:	
Thermometer				:	
pH				:	
Specific Conductance				:	
Turbidity				:	

GeoResearch

FORM 112313S.____

Summary of MSWP Table 1 Groundwater Sample Portions
Detection Monitoring

Sample Parameter	Bailer/Filtration	Container	Preservative	Holding Time
1. Volatile Organics[1]	Stainless Steel/ Unfiltered	2 40-ml glass/teflon vials	2 drops HCl to pH < 2 Cool, 4°C	14 days
2. Nitrate, COD	Stainless Steel/ Unfiltered	250 ml plastic	2 ml H_2SO_4 to pH < 2 Cool, 4°C	28 days
3. Cyanide	PVC/Unfiltered	500 ml plastic	2 ml NaOH to pH > 12 Cool, 4°C	14 days
4. Major Anions and General Parameters	PVC/Unfiltered	500 ml plastic	Cool, 4°C	Analyze pH immediately, 28 days for remainder
5. Dissolved Metals	PVC/Filtered	250 ml plastic	2 ml HNO_3 to pH < 2 Cool, 4°C	28 days for Mercury, 6 months for remainder

Summary of MSWP Table 2 Groundwater Sample Portions
Assessment Monitoring

Sample Parameter	Bailer/Filtration	Container	Preservative	Holding Time
1. Volatile Organics[1]	Stainless Steel/ Unfiltered	2 40-ml glass/teflon vials	2 drops HCl to pH < 2 Cool, 4°C	14 days
2. Semi-volatiles, Pesticides, Herbicides, PCBs, Petroleum Hydrocarbons	Stainless Steel/ Unfiltered	5 1000 ml glass (narrow mouth)	Cool, 4°C	7 days
3.Petroleum Hydrocarbons	Stainless Steel/ Unfiltered	1 1000 ml glass (narrow mouth)	Cool, 4°C	14 days
3. Sulfide	PVC/Unfiltered	250 ml plastic	2 ml zinc acetate Cool, 4°C	7 days
4. Dissolved metals	PVC/Filtered	250 ml plastic	2 ml HNO_3 to pH < 2 Cool, 4°C	28 days for Mercury, 6 months for remainder

[1] Take care to slowly pour sample down side of container to avoid degassing.

ENERGY LABORATORIES, INC.
P.O. Box 30916 1107 South Broadway
Billings, MT 59107

toll-free 800-735-4489
voice 406-252-6325
fax 406-252-6069

CHAIN OF CUSTODY RECORD

PLEASE PRINT OR TYPE ALL INFORMATION EXCEPT SIGNATURES

P.O. #: 112035

Project Name / Address: Laurel Landfill
Laurel MT

Contact Name & Phone: Margaret Hofacker
248-6771

Sampler's signature: Margaret M. Hofacker

Invoice to:
GeoResearch, Inc.
115 N. Broadway
Billings, MT 59101

Report to:
Margaret Hofacker
GeoResearch, Inc
115 N. Broadway
Billings MT 59101

Analysis Requested: MT SWP Table I

DATE	TIME	composite	grab sample	SAMPLE I.D.	number of containers	Sample Type: A W S V U O Air Water Soils/solids Vegetation Urine Other	VOC - long list 2-40mL vials,	Nitrate, COD, 250ml plastic, H_2SO_4	Cyanide 500ml plastic, NaOH	Cl^- SO_4 pH, Sc 500 ml plastic	Dissolved metals, 250ml plastic HNO3, Filtered				Comments, Special Instructions, etc.
9/21/93	1814		X	93LAU007	6	W	2	1	1	1	1				Montana SWP Table 1

1. Relinquished (signature)	Date	Time	Received by: (signature)	3. Relinquished (signature)	Date	Time	Received by (signature):
Margaret M. Hofacker	9/22/93	0924					

2. Relinquished (signature)	Date	Time	Received by: (signature)	4. Relinquished (signature)	Date	Time	Received for laboratory by (signature):
					09/22/93	0924	Landa Hoelscher

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December 31, 1992

Mr. Edward A. Thamke
Solid and Hazardous Waste Bureau
Department of Health and Environmental Sciences
Cogswell Building
Helena, MT 59620

RECEIVED
DEC 31 1992
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

Re: Closure of Laurel Class II Landfill, License No. 203

Dear Mr. Thamke:

On behalf of the City of Laurel, GeoResearch is requesting interim closure and inspection of the Laurel Class II landfill. Approval of the closure plan was received from you in a letter dated November 19, 1992. Since that time the 18 inch cap has been completed and six inches of growth medium has been placed on top of the cap. The ditches were constructed as shown on the plans. On December 18, 1992 I conducted a final inspection of the site. I checked cover thickness at 16 points on a 100 foot grid. Many of the grid points had been previously checked and found to have sufficient thickness for the cap. One point had insufficient cover and additional cover has been placed there. I also had in-place density tests run at 13 grid points. These verified that the cap was compacted to densities greater than 90% of maximum dry density (ASTM D698) although some of the growth medium was also measured and had readings less than 90%. The site is fenced and the gate is locked.

No double ring infiltrometer tests were made at this time because of the sub-freezing conditions. Verification tests with the infiltrometer will be made in the spring to ensure that the cap meets the 1x10^{-5} cm/sec hydraulic conductivity specification of 40 CFR 258. At that time the growth medium will be scarified, fertilized, and planted with the recommended seed mix to provide vegetative protection.

A hydrogeologic report presenting the findings of the recent hydrogeologic investigation is being submitted under separate cover. If you have any questions about the closure of the site, please feel free to contact me.

Sincerely yours;

Bill Bucher

Bill Bucher, P.E.
Senior Hydrologist

c: Jim Worthington - City of Laurel
D. Richardson - GeoResearch

P.O. Box 5597
Helena, MT 59604
TEL. (406) 449-3225
FAX (406) 449-2371